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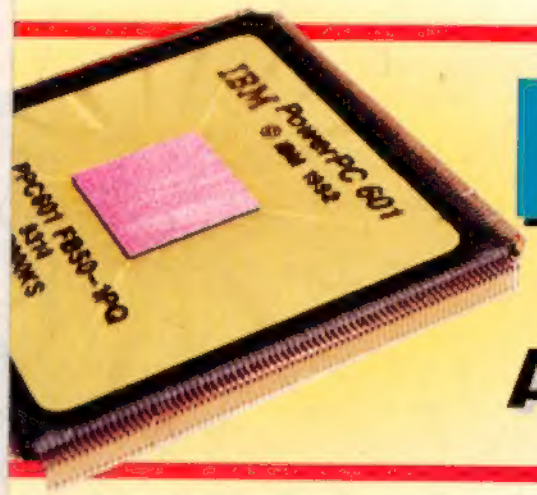

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Motorola, IBM, and Apple Bet Against Intel

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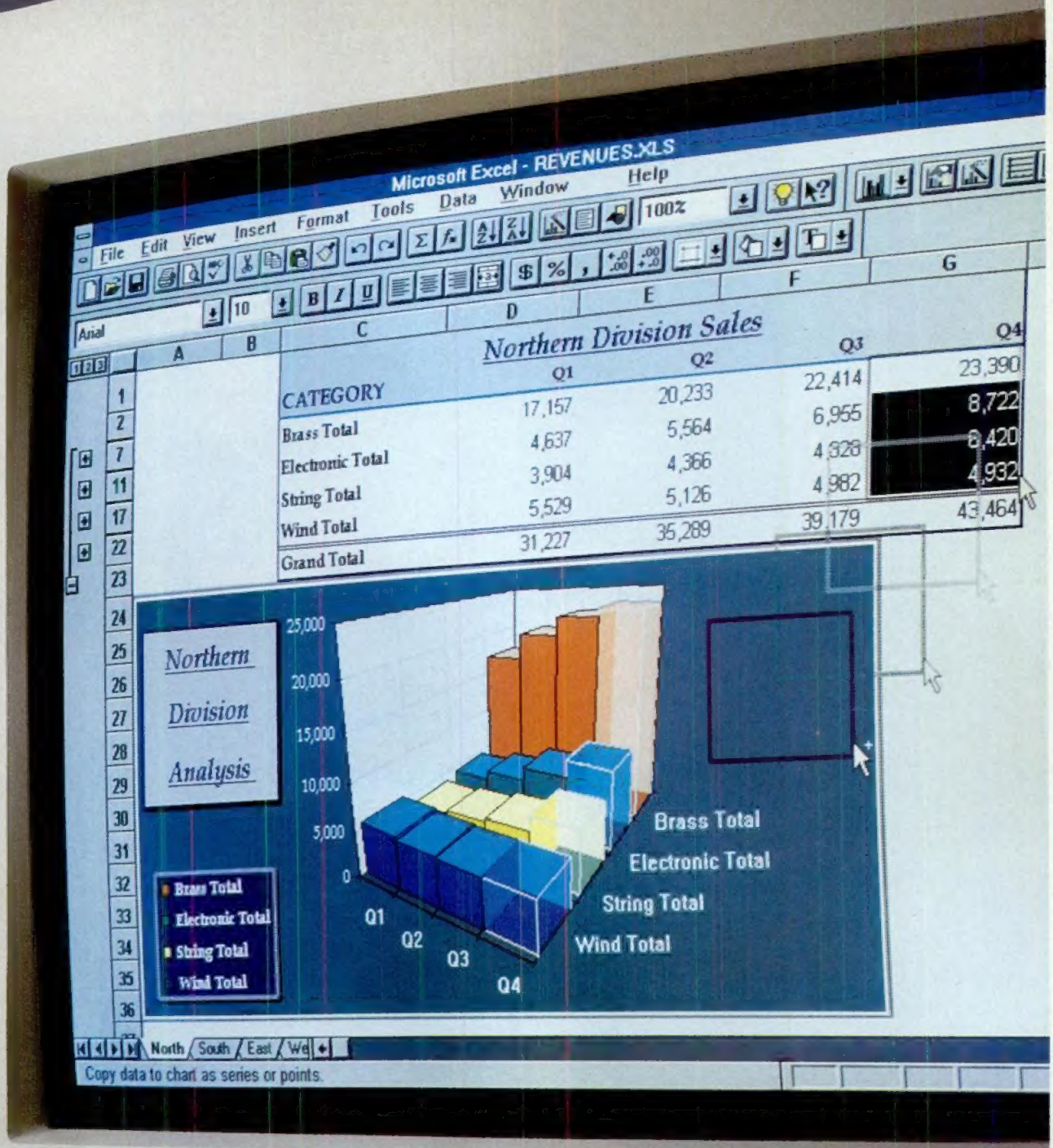
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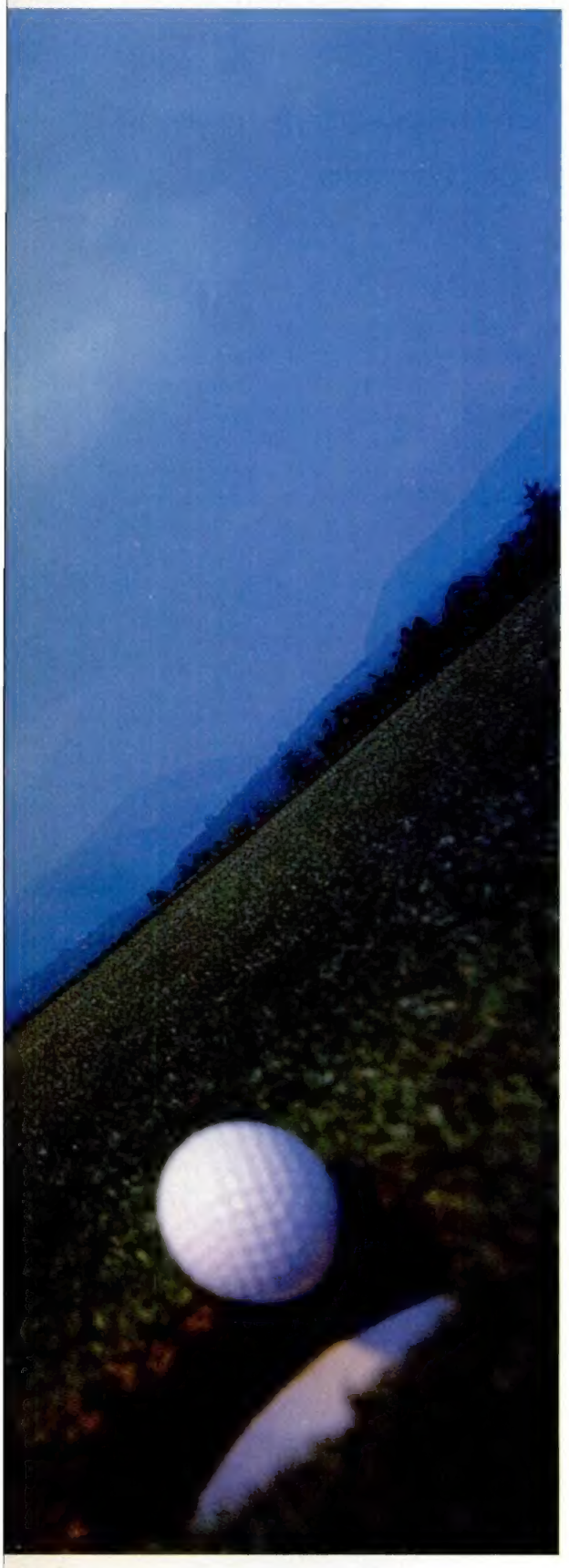

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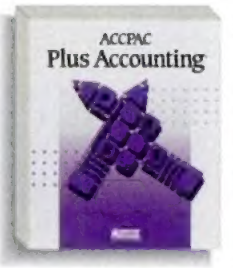

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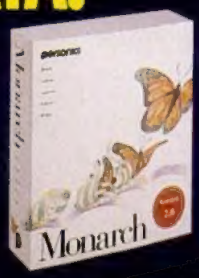

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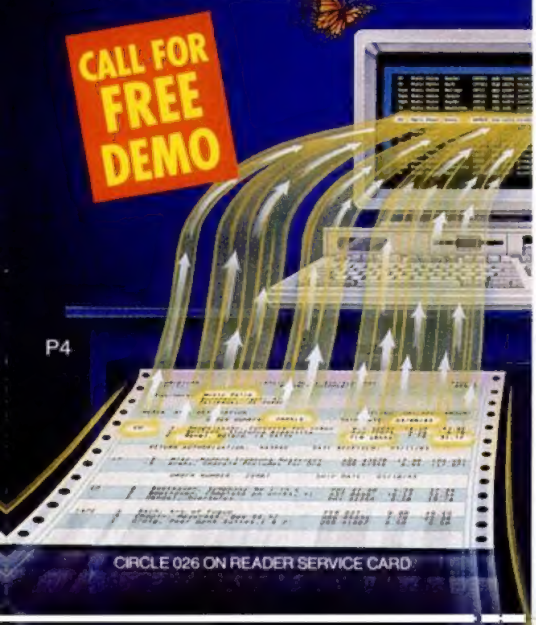

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CIRCLE 026 ON READER SERVICE CARD

Inside

CD-ing is believing. No matter whose numbers you believe, they are compelling. There are nearly 5 thousand CD-ROM titles available. One in every four machines sold this year will include an integral CD-ROM drive. And prices for CD-ROM hardware have fallen as low as $200. If numbers don't move you, then take a walk into your local computer store. You'll see breadlines of folks toting their multimedia upgrade kits home. It seems as if CD-ROMs are taking the world by storm.

But buying a CD-ROM drive is a tricky proposition with all sorts of potential for disappointments. Price-sensitive shoppers will look longingly at aging single-speed drives. Those with an eye to the future will look to the new breed of triple-speeds. In both cases we'll show you whether the performance justifies the price.

A large portion of this issue of *PC Magazine* delves into the world of the CD-ROM. First, we do what we do best: Leon Erlanger and Mike Zulich have spearheaded an intense effort that involved testing 26 CD-ROM drives in a variety of real-world situations. The data they analyze is more comprehensive then you'll find anywhere else. Next we look at how the CD-ROM world is evolving. Contributor James Karney looks at the tangled web we weave when we try to do the obvious—network CD-ROM drives. This piece is a must-read if you're thinking about sharing CD-ROMs on the network. Elsewhere on the CD front, Lori Grunin explores the Kodak Photo CD—from its humble roots as a consumer photo album to its adaptation as a professional platform for high-quality graphics. Finally, our graphics team dissects multimedia authoring systems. These tools are the stuff that CD-ROMs are made of, but working with them is a mixture of agony and ecstasy.

There's plenty happening on the non-CD front as well. We'll take you on a deep-down tour of the PowerPC—the best way to determine if this technology has a place in your future. Finally, if you're already weary of magazines hyping Chicago, make sure to read Michael Miller's column. He'll tell you what's real and what's not.—*Robin Raskin*

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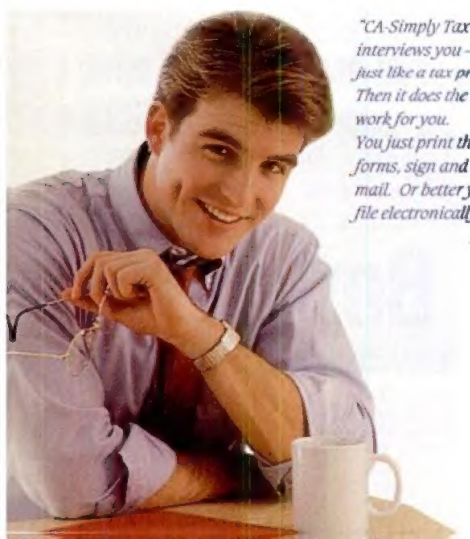

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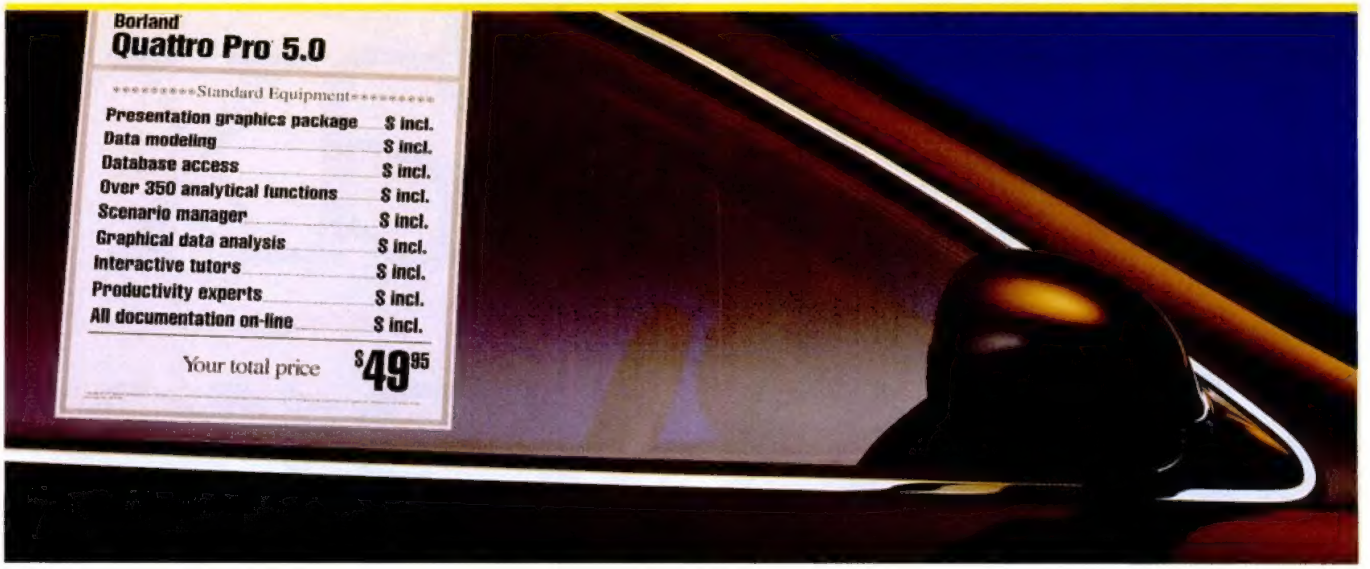

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CD-ROM

The World of CD-ROM

*With over 4,500 CD-ROM titles on the market and new ones appearing every day, a CD-ROM drive is becoming as essential as a hard disk. This multipart feature tackles three key issues: which CD-ROM drive to buy, how to attach a CD-ROM drive to a network, and what Kodak's exciting Photo CD technology can do for you.....***109**

CD-ROM Drives: Going Mainstream

BY JOHN R. QUAIN The time is right to buy a CD-ROM drive—but which one? We test 26 models to determine which ones offer the right performance and features for applications that range from multimedia to database searches. We even tested how the analog audio quality of the drives stacks up against a plain-vanilla CD player **110**

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Cover photography by Geoff Spear

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CD-ROM

Photo CD

A Photographic Memory for the Digital Age

BY LORI GRUNIN Despite what you might have heard, Kodak Photo CDs aren't just for looking at wedding photos on your TV screen. Professionals in areas such as pre-press, photography, and electronic publishing are rushing to jump on the Photo CD bandwagon. *PC Magazine* takes an in-depth look at this technology and some of the issues that still need to be settled 157

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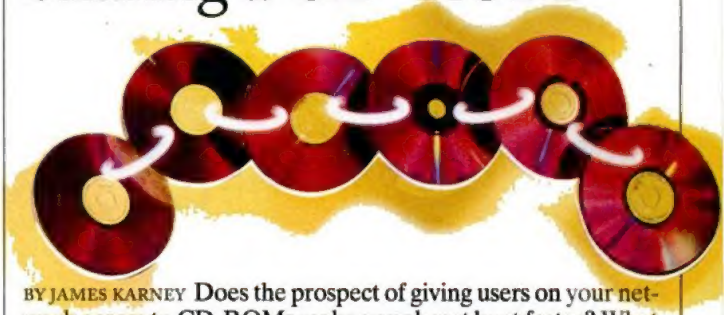
Sharing a CD-ROM



BY JAMES KARNEY Does the prospect of giving users on your network access to CD-ROMs make your heart beat faster? What are the benefits, and are they worth the headaches? We explore some of the current solutions for adding a CD-ROM server to your network—and some of the problems they may cause 171

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PowerPC

PowerPC: Your Next CPU?

BY JOHN CLYMAN Apple, IBM, and Motorola are positioning their new RISC processors to challenge Intel's *x*86 line head-on. But taking the PowerPC mainstream will require more than innovative technology. Here's how its backers plan to build a systems and software infrastructure to make the PowerPC appealing—and perhaps redefine computing in the process.....181

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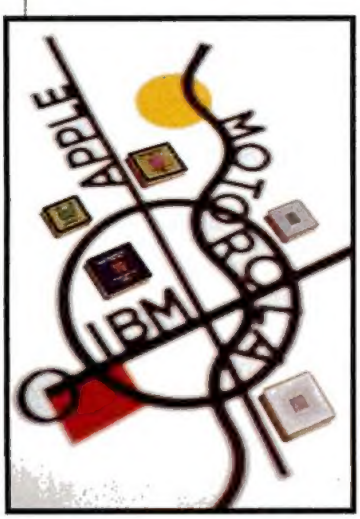

Looking Inside the PowerPC 601

BY NICK STAM How does the first PowerPC chip exploit RISC's potential? This close-up look presents all the details, from instruction pipelines to look-aside buffers 199

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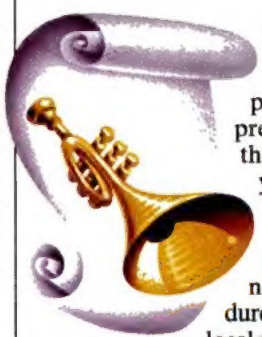
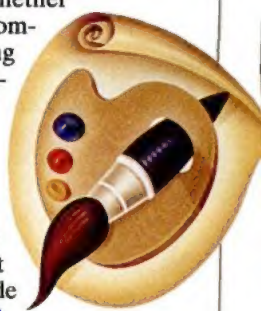
Multimedia Authoring Software

Creating Multimedia to Die For



BY ROBIN RASKIN Finally, it's okay to say *multimedia* without causing a panic. It's no longer an application without a purpose; multimedia is all around us, and its presence will become even more visible in the near future. Whether you're creating a computer-based training application for learning how to follow new company procedures or a kiosk for your local record store, authoring programs allow you to create dazzling multimedia applications. *PC Magazine* reviews five packages that offer different means to the same end so that you can decide which one is right for you 209



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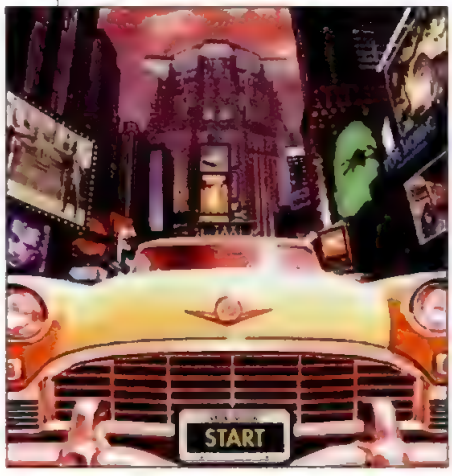

Prepare for your next New York City taxi ride with a practice trip in Hell Cab (page 404).

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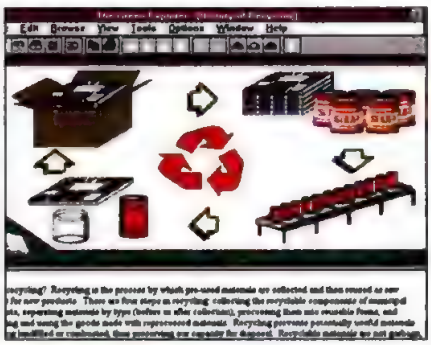

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BY DON WILLMOTT

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Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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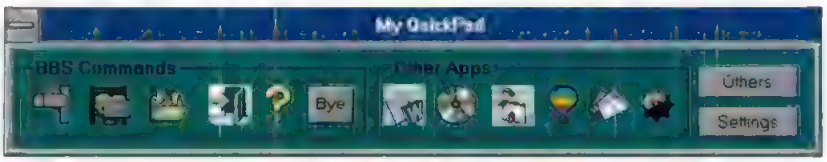

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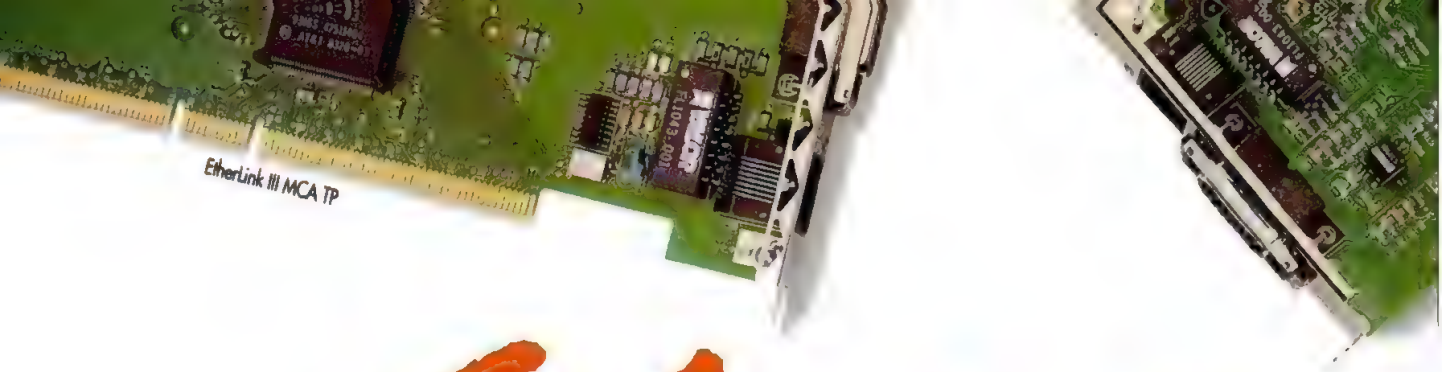

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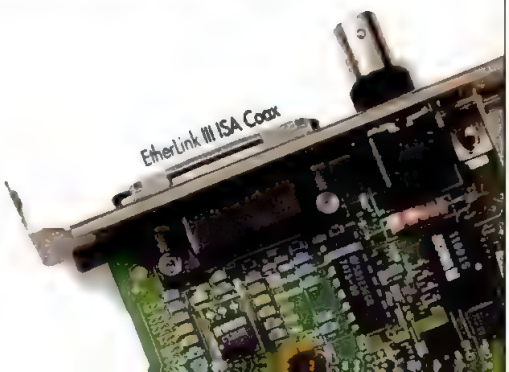

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Letters

PUMP UP THE COLOR

I eagerly awaited your roundup of graphics accelerators in the December 7, 1993, issue ("Pumping Pixels"), and indeed it was worth the wait. As always, the coverage was both comprehensive and informative. I will refer to it whenever I am asked to configure and set up a Windows-based system.

Gregory Barrett
Vancouver, British Columbia

Your review of video boards makes passing reference to a pertinent issue, namely the importance of having the current drivers for a board. Unfortunately, your charts do not specify the dates or version numbers of the Windows drivers used in testing.

When *PC Magazine* tests products like video boards, it would be helpful to note what date or version number you tested for each driver. To state simply that the manufacturer sent updated drivers during the test period leaves the reader unsure of just what exactly has been tested.

Patrick Joyce
Long Beach, California

In the past year, *PC Magazine* has conducted three separate surveys of Windows accelerator boards. The result has been three groups of product recommendations and totally different, noninterchangeable benchmark test scores. If your indecisiveness in the first two surveys wasn't enough to confuse readers, your latest comparison surely did the trick with its often conflicting numbers and myriad of Editors' Choice awards and honorable mentions.

Fortunately, one good thing stands out: the new Winstone test, which incorporates a series of real-world tasks using actual Windows applications. It's interesting to note that in this practical test of accelerator boards, all 43 products produced scores within 9 percent of one another's Graphics WinMark scores. This confirms my own suspicion that most accelerators probably speed things up about the same under real-life Windows conditions.

John J. Puccio
Martinez, California

Graphics Hardware
Pumping Pixels
The new breed of graphics accelerator boards raise the bar on Windows video performance

The Winstone test finally provides a real-world testing environment.

• *PC Magazine* benchmark testing is always being refined and improved to provide better and more accurate product evaluations. Benchmark test versions are not always backward-compatible, so previous test results cannot be directly compared with current results. Video drivers are frequently revised and updated. Regardless of the version used in PC Magazine Labs testing, you should always seek updated drivers from the vendor.—Ed.

486 SHOPPERS' PARADISE

Congratulations on an outstanding "486 Buyers' Guide" (December 7, 1993). It was the most comprehensive review of PCs I have seen in a long time and I truly agree with the Editors' Choice of the Dell OptiPlex MXV, which I use at work. *PC Magazine* is top-notch when it comes to benchmark-testing 191 products in the same category. My compliments to the staff.

Sven Vandermespel
White Plains, New York

Though I enjoyed your "486 Buyers' Guide," I propose that you concentrate your benchmark testing on the basic system offered by the distributor, at the basic system price. You can qualify the test scores with benchmark tests of the types of video, hard disk, and other subsystems offered by the distributor.

Readers should be advised on subsystem target performances required to optimize overall system performance. Since most distributors will customize systems at no additional cost (except for component prices), your test results on the systems provided for your reviews will vary tremendously with subsystem configurations and are hardly indicative of the capabilities of a system purchased by the average consumer.

Steve Janes
Fairchild AFB, Washington

• For PC system reviews, we test the configurations most likely to be useful to the typical reader of *PC Magazine*. Other articles have examined how configurations affect performance. Also in the December 7 issue is our review of 43 video adapters ("Pumping Pixels"), where we compared performance on systems with 8MB and 16MB of system RAM. In "The Perfect PC" (July 1993), we discussed the performance effects of the amount of CPU cache, the amount and type of disk cache, the type of video bus (ISA, EISA, or local bus), and the type of disk interface (SCSI or IDE).—Ed.

CURLING UP WITH A CD-ROM?

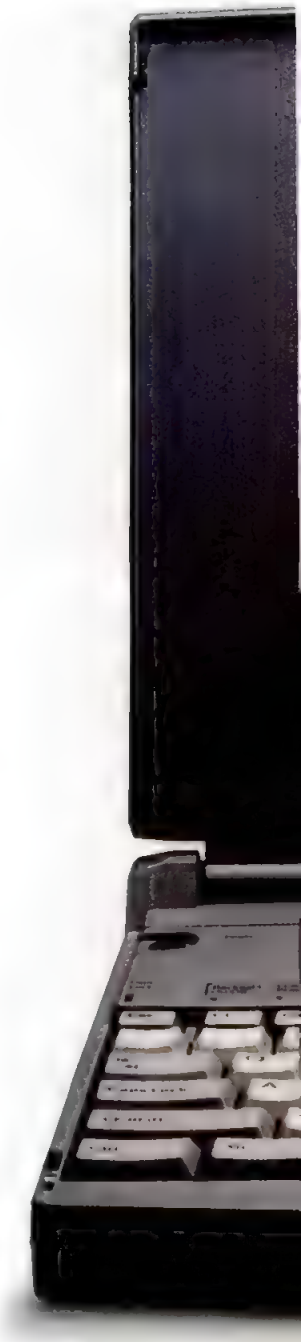
I live and breathe by my PC. Work, a small dash of entertainment, and some financial management all keep my keyboard warm, so that the last thing I want is to be chained to the thing to read the new CD-ROM version of *PC Magazine* ("*PC Magazine* Goes CD," December 21, 1993). Although CDs are easier on the tree population, magazines are easier on my retinas.

James Hutchison
Moose Jaw, Saskatchewan, Canada

PROJECTING AHEAD

John C. Dvorak's December 7, 1993, column on desktop videoconferencing was one of the most ridiculous columns I've ever read. First off, the title, "The Research Is Dead Wrong," is misleading:

Remember when color TVs suddenly became affordable? Can you say déjà vu?



Unless you still watch a black and white TV and listen to 8-track tapes, price is probably the only thing stopping you from getting a color notebook. In which case, we'd like to introduce you to the Bravo NB. Not just because it's affordable, but also because it has features you normally don't find on notebooks costing hundreds more. Like the most advanced Dual Scan STN technology, which gives you 256 bright, clear colors on a full-size 9.5" screen. To make sure you won't have to wait to see those colors, it has a powerful Intel 25MHz 486SX microprocessor, local bus video and 512KB video memory. It also has 4MB RAM that can be expanded to 20MB and up to a 170MB hard drive. There's even a Type III PCMCIA expansion slot so you can send or access information from anywhere, as well as enough other features to fill that column to your right. And since our resellers perform as well as our computers, you can get one right away by calling 800-876-4AST. All of which should make choosing a color notebook as simple as, well, black and white.

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LETTERS

The research that Dvorak cited in his article showed low demand for desktop videoconferencing equipment during the next year, which in itself is not wrong—it merely doesn't project into the distant future to consider the potential uses of videoconferencing. Dvorak builds his whole argument on refuting the research by using examples from the future, instead of simply noting that the research projections were shortsighted.

Jerald Levinson
via PC MagNet

THE INTERACTIVE HIGHWAY SCAM?

Left and right, *PC Magazine* columnists are attacking multimedia and the information superhighway, two of the most exciting developments in the computer industry.

The recent wave started in the November 9, 1993, issue, with Bill Machrone's column "What's Wrong with Multimedia" and John C. Dvorak's "Game Machines: Trend or Fiasco?" Machrone came across as a pessimist when it comes to the multimedia and information superhighway, while Dvorak's comparison of the 3DO, CD-I, Atari Jaguar, and other new game machines to the Commodore Amiga is ridiculous, since these machines are targeting gamers, not computer users.

Machrone's December 7, 1993, column, "The Convergence Scam," is riding the crest of this anti-multimedia wave. Once again, Machrone says that Hollywood and computers will never converge, and that we can all kiss our ideas of 500 channels and interactive entertainment goodbye. Interactive entertainment on the digital superhighway is an exciting revolution. Contrary to Dvorak and Machrone's beliefs, most folks are looking forward to this revolution, and I for one am ready to shell out the big bucks for game machines.

Brady Brock
Nampa, Idaho

After reading Bill Machrone's December 7, 1993, column, I came away pondering two of the column's points: that television and the personal computer are separate and distinct communication devices which should not be combined, and that the expanding "bandwidth" of electronic communication will soon run out of usable content. Both thoughts are valid issues that deserve further exploration beyond a cursory if not muddled mention in Machrone's column.

Bruce Mayer
via PC MagNet

ACCEPTING C++ EXCEPTIONS

A refreshing breath of air that does not espouse any particular party line, "Making Exceptions with C++" (December 21, 1993) is a great article that tells the facts as they are.

Discussions of the truth behind compliance with the standard are a welcome

Without convergence between Hollywood and computers, we can all say goodbye to our 500 channels and interactive entertainment.

means of letting the public know beforehand that a product has used methods that are unsafe or below existing standards. The only thing missing from this very complete coverage of C++ is a mention of the C++ library, which is a recent addition to the standard.

William L. Hartzell
Garland, Texas

TRADE SHOW BUNNIES: ANOTHER VOICE

Bill Machrone complains of booth bunnies in his column "Trade Show Travails" (November 23, 1993), noting that the practice of hiring attractive young women to entice show visitors into companies' booths is sexist. What would the male equivalent be, booth bucks?

Machrone's suggestion of hiring as many men as women for this role is a reasonable one. Especially when considering that those of us who are looking for interesting and useful products are not interested in fluff, anyway; we want to speak with a technically oriented person—male or female—who is capable of answering our practical, real-world technical questions.

Stephen M. Dunn
via PC MagNet

BON VOYAGE TO SEEDY CD-ROM ADS

It was with great relief that I read your new policy relegating "adult" computer ads to the Classified section as text-only advertisements (Letters, December 21, 1993). During the past year I had become increasingly concerned over the inclusion of more and more such advertising that was ever more graphic in content. There is, perhaps, a proper place for adult material, but a publication like yours is not the place.

Morris Kaplowitz
Reston, Virginia

Your decision to disallow adult computer product advertisements in your Premier advertising section goes beyond a publisher's privilege to monitor, and censor by selection, any advertising submitted for publication. Moreover, this ventures dangerously toward acquiescence to vocal pressure groups.

Tragically, *PC Magazine*'s response to the issue falls in line with the current "PC" climate—and I use the term here in its abhorrently narrow-minded, politically correct cultural sense—which sacrifices forthright honesty in favor of the simpering euphemisms now employed by ideologies.

Wayne E. Nail
Bethesda, Maryland

CORRECTIONS AND AMPLIFICATIONS

The December 7, 1993, New & Improved column incorrectly described the pricing for the Xerox Personal Printer. Xerox has no list price for this printer; its street price will be under $299.

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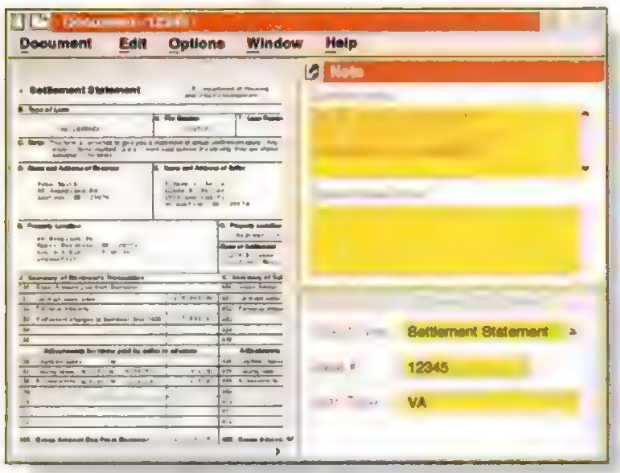

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CIRCLE 063 ON READER SERVICE CARD

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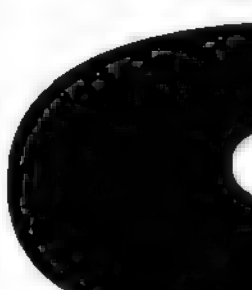

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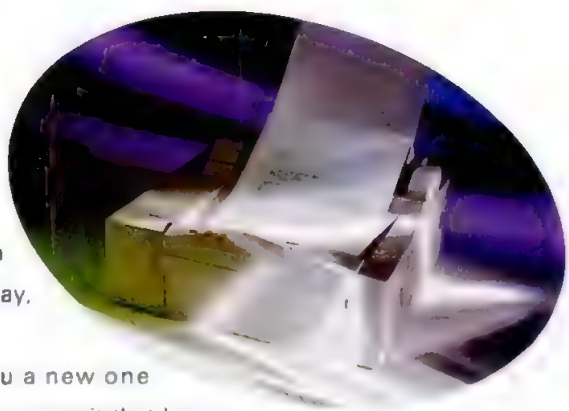

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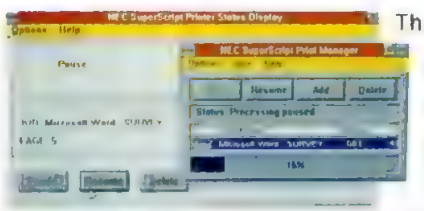

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CIRCLE 153 ON READER SERVICE CARD

RUNNING WINDOWS WITHOUT NORTON DESKTOP? YOU PROBABLY SWIM AFTER A BIG MEAL AND THEN RUN AROUND THE POOL WITH SCISSORS, TOO.

Listen up, you risk-takers. What would your mother say if she saw you now?

No doubt she would tell you to go right out and get the new Norton Desktop 3.0 for Windows before you damage yourself. Or your computer.

That's because NDW 3.0 not only enhances your work, it's also the safest way to run Windows short of tapping directly into Bill Gates' subconscious. Made by Peter Norton, it's packed full of utilities to provide a safer working environment.

Like our new Norton AntiVirus 3.0, which protects your system against over 2,300 known viruses, and our new Norton BackUp™ 3.0 with enhanced support for SCSI drives. There's also the new UnErase, to recover accidentally erased files. Disk Doctor for automatic disk diagnosis and disk repair. And a Fix-It disk with a full collection of DOS utilities to recover and repair files or entire disks, even if you can't run Windows. And now for the first time, you'll be able to run Speed Disk under Windows to boost performance.

In addition, NDW 3.0 simplifies Windows for you by integrating file and program management. And while the new FileAssist will allow you to easily manage your files without having to leave your applications, the new Day Planner will allow you to easily manage your life. And who doesn't need a little help with that?

Plus, the new "push button" Control Center allows you to customize pull-down menus, icons, toolbars and a lot more to make sure that Windows looks and works exactly the way you want it to.

So the choice is yours. Either see your local dealer, call 1-800-628-4777, ext. 9111 to order, or live a life full of danger and recklessness, running Windows without Norton Desktop 3.0 for Windows and sprinting around pools with sharp objects until you finally put somebody's eye out.

Of course, you would be absolutely crazy not to pick up your own copy of NDW 3.0 today. And remember, don't run Windows without it!

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CIRCLE 117 ON READER SERVICE CARD.

TVs Get Smart

Computer chips transform television.

Intelligent is not a word that normally describes a television set, but when a cable-equipped TV meets a computer, the offspring is smart. Smart enough, in fact, to navigate the oncoming digital tidal wave.

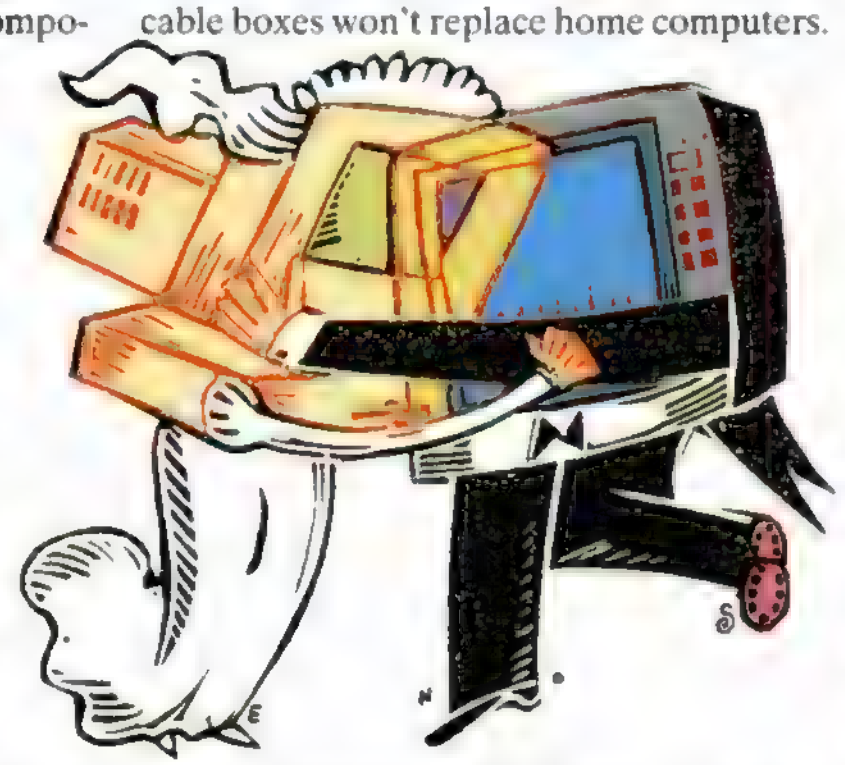
The cast of characters gambling on smart TV includes names familiar in the computer industry—Hewlett-Packard Co., Intel Corp., Kaleida Labs, Motorola, and Silicon Graphics. They're all experimenting with technology that weds workstation components with cable boxes destined not for computer scientists but for throngs of consumers who've never touched a PC before. They've teamed up with cable box manufacturers to develop prototype systems that will begin testing this year.

Intelligent cable boxes, or set tops, bridge the gap between today's analog TV and tomorrow's interactive digital TV. Most will contain a processor, a graphics chip, an infrared remote controller, and a cable tuner. They actually do something with the digital signal as well as display it. To manage 500 channels over existing coaxial cable, smart cable boxes will incorporate an MPEG chip to decode the compressed digital audio and video information as it's received.

Prototypes abound. Today's experimental models use chips such as Motorola's PowerPC, Intel's 486, the ARM 60, and the MIPS 4000. To generate high-quality animation and 3-D graphics, they rely on dedicated graphics controllers such as the 3DO graphics chip or Kaleida Labs' Malibu chip, which is used in Scientific-Atlanta's prototype box (code-named Project Skywalker).

Hewlett-Packard has developed two space-age prototypes: One uses a Motorola processor; the other uses an Intel processor. Both will offer video-on-demand services and interactive programming so you can watch what you want when you want it.

But are they PCs? Just because they have processors and graphics chips, these smart cable boxes won't replace home computers.



They're strictly for TVs. They run proprietary operating systems, not DOS or Windows. For PCs, new peripherals such as cable modems from Zenith Data Systems and Intel provide direct access to CompuServe, the Internet, and Prodigy without dialing over phone lines.

With all the different players, which set-top platform will dominate? We'll have to wait a few years before cable-based multimedia software standards are established. In the meantime, cable companies will lay fiber-optic lines to neighborhoods and develop two-way cable technologies. By that time, a computer chip may reside in your TV.—*Christopher Barr*

Illustration by Randall Enos

Magic Mail

NOW THAT THE WORLD IS WISE TO the limits of Newton, EO, and Zoomer personal digital assistants, the first fruit of the General Magic partnership is about to be picked. Later this year, Motorola and Sony will introduce personal intelligent communicators (PICs) with PDA features, and they're not just for the PDA market. General Magic is developing technologies to make these hand-held devices truly useful to e-mail junkies hooked on keeping in touch.

The key technology from General Magic is a platform-independent programming language called Telescript, which uses *agents* that speak communications the way PostScript speaks graphics. At first, programmers will use it to develop applications that run on General Magic's Magic Cap operating system.

As with PostScript, which is embedded in printers, Telescript will be incorporated in the public network service infrastructure, like AT&T's new PersonaLink communications service. The transport can be wired, wireless, CDPD, infrared, or over a LAN.

A Telescript agent is a program in disguise. Telescript works by sending the agent into the network, where it's smart enough to route itself to a user's mailbox, fax, or PIC. Marc Porat, chairman and CEO of General Magic, says agents will have smart content. "You could attach a button that says 'schedule an appointment,' and the agent would look for a time filter and distribution lists and schedule the appointment," he says.

You may first mistake Motorola's PIC for a Newton-like PDA, until you launch into Magic Cap's video-gamelike interface. Its first application will be Magic Mail, which lets you send Telecard messages by infrared or modem. It will also come with PersonaLink and RadioMail accounts.

Several third-party applications are under development for the Magic Cap platform. Intuit will have a version of Quicken, Traveling Software is working on a link to your Windows or Mac desktop, and PenWare will ship the PenCell spreadsheet. On the communications side, Lotus is reportedly developing a version of cc:Mail for Magic Cap.—*Christopher Barr*

Pipeline *By Robin Raskin*

Binding Agreements

Shrinkwrap agreements have their rightful place in this world. They're one of the few ways software developers have to protect their intellectual property. In most cases, the licenses seem to be fair and reasonable agreements between vendor and buyer. According to the Software Publishers Association, most of the licenses have even become more lenient over the past few years. In fact, many agreements now include concessions such as concurrent use and use on multiple machines to accomodate buyers' mobile working style.

There are two vendors I know of that are pushing the shrinkwrap envelope the other way. I'm curious to know just how far you think they can go. Oracle and Sybase, two powerful players in the client/server world, have shrinkwrap licenses that prohibit the publishing of performance and benchmark testing without their consent. I know that most of you don't go around publishing benchmark tests, but this one hits us pretty close to home.

I can surely understand where Sybase and Oracle are coming from. The databases they sell are perhaps the most complex commercial apps available. They feel they have the right to know who is testing, what they're testing, and how the published results will look. A contractual agreement assures these rights.

Over the years, this agreement has caused *PC Magazine* plenty of headaches. Two years ago, as we began testing SQL servers for a comparative review, we were thwarted by the agreement that was part and parcel of Oracle 6. It stated that you could not use Oracle's package for the purpose of reporting benchmark test scores without the company's explicit permission. Tear the shrinkwrap off the box, the clause goes into effect.

Being good corporate citizens, we attempted to obtain that permission. We failed. Rather than violate an agreement, we chose to review the package without reporting any "numbers." We also disqualified Oracle from the Editors' Choice race since we could not, in good conscience, recommend a product without sharing the test results.

Last year Oracle granted us permission to print benchmark test results. Sybase then instituted a clause that would prevent the dissemination of test results without consent from Sybase. Ultimately, it, too, waived this requirement for *PC Magazine,* but not before we could assure Sybase that our testing met its expectations.

I worry that next year there will be even more vendors adding "benchmark provisions" to their licenses. And I worry that a shrinkwrap agreement that prohibits us from publishing performance numbers might lead to even more unreasonable agreements—maybe even ones that say we can't review the software at all!

When Ziff-Davis developed PC Bench and WinBench, we were faced with a similar "control" problem. How would we know that vendors were accurately portraying test results? Our license permits anyone who uses our benchmark tests to print the results as long as they fully disclose the testing environment. This ensures that the results can be repeated and validated. I'm in favor of binding agreements, except when I see theknots getting a bit too tight.

Robin Raskin is editor of PC Magazine.

ISDN on Hold

WHAT ARE MANUFACTURERS DOing while the world waits for digital phone service? For years now, ISDN (Integrated Services Digital Network) has been the Next Big Thing in high-speed telecommunications. And ever so slowly, the goal of end-to-end digital communication over the existing copper-based network of phone lines is coming into sight. But as we wait for 128-kilobit-per-second ISDN to work its way into our homes and offices, some vendors are supplying analog workarounds for several of its promised features.

Simultaneous data and voice. Several companies now offer modems based on an AT&T chip set that allows simultaneous voice and data transmissions to the same phone number. If both parties have such modems, they might discuss the contents of a fax as it was transmitted, or play interactive games and talk as they did so. Multi-Tech Systems' MultiModem PCS (800-328-9717) is geared toward PBX-style switching capabilities, while AT&T Paradyne's DataPort 2001 Multimedia Communicator (800-662-2553) includes software for whiteboard sketching and drawing during phone conversations. AT&T's enabling technology, called VoiceSpan, increases the capacity of a phone line by splitting one line into two virtual channels. One channel transmits audio, the other transmits data or graphics. A simultaneous voice/data transmission entails speeds of about 4,800 bps for each half, though both vendors are implementing technology to shift data speeds to 14,400 bps dynamically when there's silence on the voice side.

Personal phone numbers, caller ID, and other call-management services. Many regional phone companies, such as U.S. West, are offering advanced phone services to residences and businesses. These advances are possible in part because of the implementation of the ITU-TSS (International Telecommunications Union, formerly the CCITT) No. 7 Signaling Standard in anticipation of ISDN, which interconnects ISDN systems.

Group 3 versus Group 4 faxing. Group 4 was once expected to overtake Group 3 as the standard for digital faxing. But Group 3 has evolved to approach Group 4's speeds. And the ITU has already approved Group 3 for transmission over digital networks. With 97 percent of the world's fax machines supporting Group 3, support for the "advanced" technology of Group 4 is increasingly irrelevant.

Who's lagging behind? PC manufacturers, for one. The faster speeds possible with ISDN (and with the coming V.fast-class, V.terbo, and V.34 28,800-bps modems) are far too much for a traditional serial port to handle. The ITU is mandating use of a high-speed interface (such as an EIA-530-A, ITU V.35, or EIA-449 port) with all V.34 modems. But no PC sold now has any of those interfaces.

Is ISDN dead? No. Attention must still be paid to the nation's ubiquitous network of copper wires. The coming information highway can't wait for fiber everywhere. And some of the capabilities that reduce the load on the copper lines between your phones and the nearest switching office can only happen once ISDN has finally arrived.

—Angela Gunn

Virtual Reality Looks for Markets

THE BIGGEST PROBLEM VIRTUAL reality application developers may have in the next few years is learning how to market to trigger-happy teenagers instead of Uncle Sam. The recent Virtual Reality Expo in New York City made it clear that developers of Navy pilot training simulations and the like are scrambling to turn their apps into expensive arcade games destined for your local mall.

The 500 conference attendees saw demonstrations of VR apps like San Diego-based Greystone Technologies' swooping ride on the back of a virtual pterodactyl. You stand in front of a projection screen controlling the bird's flight through a twisting, steep-walled canyon toward a virtual castle, inside of which lurks a virtual dragon.

There were also examples of aerial dogfighting games far more sophisticated than anything available today, with their roots firmly in military training.

Fun and games aside, serious applications were very much in evidence, too. Cine-med, located in Woodbury, Connecticut, has developed a realistic simulator that lets medical students operate on virtual organs that are created by digitizing 3-D models and assigning them mass and tactile characteristics. And NASA showed off its use of VR simulations to help astronauts train for last December's Hubble telescope repair mission.

Back on Earth, where potential users wonder about the costs of these VR apps, Chicago-based VREAM showed a $795 out-of-the-box end-user Virtual Reality Development System that lets nonprogrammers create and enter a virtual world using standard hardware. It's a good way to get a feel for VR concepts.

Of course, much of what was displayed at the conference is still far too processor-intensive to have a place in the PC market. In fact, Silicon Graphics seems to be almost synonymous with virtual reality. But as powerful Pentium chips take hold, more high-end VR apps are sure to find their way to the business desktop.

But is business really ready for virtual reality? The most interesting moment of the conference occurred when hundreds of virtual reality enthusiasts gathered to watch videos of VR apps in action. In one, a businessman donned a virtual reality helmet to navigate through a 3-D spreadsheet, and the audience laughed uproariously. If *they* thought he looked ridiculous, what should *we* think?—*Don Willmott*

Top Retail Software

Current ranking	Last issue	Product, company
1	1	**MS-DOS 6.2 Upgrade** *Microsoft Corp.*
2	5	**Quicken 3 for Windows** *Intuit*
3	13	**Quicken 7 for DOS** *Intuit*
4	10	**MS Office 4.0 for Windows Upgrade** *Microsoft Corp.*
5	8	**MS Windows 3.1** *Microsoft Corp.*
6	7	**Quattro Pro 5.0 for Windows** *Borland International*
7	6	**MS Works 3.0 for Windows** *Microsoft Corp.*
8	—	**WordPerfect 6.0 for DOS** *WordPerfect Corp.*
9	—	**QEMM 7.0** *Quarterdeck Office Systems*
10	3	**TurboTax for Windows HeadStart 1993** *ChipSoft*
11	—	**Procomm Plus 2.01** *Datastorm Technologies*
12	4	**TurboTax for DOS HeadStart 1993** *ChipSoft*
13	15	**Procomm Plus for Windows 1.02** *Datastorm Technologies*
14	9	**MS Office 4.0 for Windows** *Microsoft Corp.*
15	—	**WinFax PRO 3.0** *Delrina Technology*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending December 11, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information adapted from a compilation by Ingram Micro.

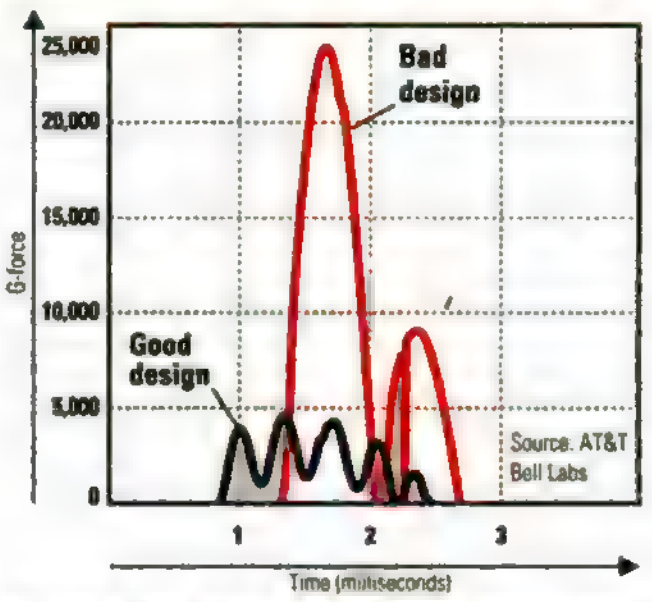
Good Vibrations

DROP A NOTEBOOK COMPUTER ON the ground and terrible things can happen. That's why the electronic packaging research team at AT&T Bell Laboratories has spent the past year abusing notebooks in the name of progress—to develop a casing rugged enough to survive such mishaps.

The lab is testing a material that protects fragile components from damaging vibration by converting kinetic energy produced from impact into heat. Eventually, notebooks swaddled in materials such as Sorbothan or Norsorex—dead rubber, as it's known in the lab—will survive dangerous falls. Ideally, a notebook should be able to withstand a fall from 4 to 6 feet onto concrete.

Bell Labs' research scientist Suresh Goyal is designing the shock-absorbing material (invented some 20 years ago for the sneaker industry) so it's light and thin enough for consumer products. "You want optimum deac-

Don't Try This at Home



The red line shows the series of shocks a notebook suffers during a fall. The blue line shows the cushioning effect of "dead rubber."

celerating force for the amount of material used, and you want to spread these properties over a temperature range. Visco-elastic polymers such as dead rubber can be engineered to give you this force characteristic," explains Goyal. "We will coat the casing with materials that are 'dead' and design the housing in such a way as to attenuate shock transmitted to fragile components."

To observe a phenomenon called *relaxation,* he purposely drops his subjects (one is a forthcoming model from NCR), videotapes the crashes at 40,000 frames per second, and then analyzes the physics of the encounters using software he designed.

The computer simulations uncover valuable data: One fall can produce from 10 to 20 impacts; and the duration of an impact is a few milliseconds. Conclusion: A material that's able to dissipate energy through relaxation in that duration is a good candidate material. Most polymers will show deadness at some temperature, explains Goyal, but the challenge is to engineer the material so it will behave consistently at a wide range of temperatures.

Once researchers understand the properties of dead rubber and learn how to use it in just the right amounts, it could be used to dampen vibrations not only in notebooks but also in sports equipment and power tools. —*Carol Levin*

Don't Pollute, Telecommute

TELECOMMUTING WAS ONE OF THE growth industries of the 1980s; its growth curve was outstripped only by the cottage industry that grew up around writing about the telecommuting phenomenon. To all the already hashed-out pro and con arguments (casual dress; job-sharing; zero travel time; isolation; out of sight, out of mind) you can add one more argument favoring the trend, courtesy of Uncle Sam and the Clean Air Act of 1990: Telecommuters working for big companies count as people who don't drive to work.

One of the motivating forces behind telecommuting is a provision in the law that requires all companies with more than 100 employees "to reduce solo-driving among their employees." Another factor is stress. "There are negative productivity and morale effects on the good old urban information worker who's spending an hour and a half to two hours getting to and from work while inhaling carbon monoxide," says Jack Nilles of JALA International, a telecommuting consultant. Enlightened management is recognizing that employees who balance work and family life are productive employees.

Telecommuting satisfies the legal mandate of increasing the number of riders per car from 1.3 to 1.5, and it is estimated to save 1.5 billion gallons of fuel and prevent 3.5 million tons of carbon from polluting the air by the year 2000. According to the EPA, if you walk, bicycle, ride transit, or telecommute from home, you count as one employee arriving at work in zero vehicles.

Both large and small companies are carefully testing the waters. "Telecommuting and a few other technology-based solutions are breakthroughs associated with compliance," explains Jerry Cashman, alternative work options manager for Hewlett-Packard Co. Telecommuting is part of the corporate culture for 500 of HP's 56,000 U.S. employees.

The technology that's making telecommuting more practical includes low-cost PCs and electronic mail as well as client-server computing and fast modems, which cut down on the amount of data going over a phone line and move the data faster. "Given current technology, a reasonable expectation is for a telecommuter to work from home an average of two days per week. That will go up as ISDN, ATM, and various forms of teleconferencing become cheaper. The biggest problem is convincing companies that they don't need a big capital investment in equipment. Easily half of prospective telecommuters already own their own PCs or will buy their own modems and software, and 80 percent still use 'sneakernet,'" says Nilles.

There are exceptions. Donna Cunningham, media relations manager for AT&T Bell Laboratories, conducts business from her home in Vermont with the help of multiple phone lines, a videophone, a cellular phone, and a PC that provides access to international offices as well as to the network located in the company's New Jersey headquarters. And some engineering firms have wideband data transmission lines so CAD engineers can access large image databases. "But that's a small fraction of the total telecommuting workforce. Most telecommuters are with smaller firms—teleguerrillas," says Nilles. According to the market research firm Link Resources, 77 percent of all telecommuters work for firms with fewer than 100 employees.

Vermont telecommuter Donna Cunningham, media relations manager for AT&T Bell Labs, keeps in constant electronic contact with New Jersey headquarters and worldwide offices.

Before you establish a program, you should decide what you want to accomplish, advises telecommuting consultant Michael Dziak of Inteleworks in Atlanta. Whether your goal is to improve morale, reduce turnover, decrease pollution, or increase productivity, the first step is to set up a telecommuting task force to design a program, select positions that are adaptable to telecommuting, and select 10 to 50 employees for a six-month trial. Then you formally measure changes in productivity. "With a well designed program, you can expect productivity increases from 10 to 20 percent. Rarely are there decreases in productivity," notes Nilles.

Skeptical managers' most common question, reports Dziak: "How do you know people are working at home?" His answer: "How do you know they're working now?"

—Carol Levin

Telecommuting Facts

- Today there are 7 million telecommuters. By 2000, there will be an estimated 25 million.
- According to the 1990 census, over 58 percent of U.S. employees are knowledge workers who exchange information with someone else.
- Thirteen severely polluted cities in California, Connecticut, Delaware, Illinois, Indiana, Maryland, New Jersey, New York, Pennsylvania, Texas, and Wisconsin must comply with the Clean Air Act's "average vehicle occupancy" rule by November 1994.
- The Employer Commute Options Program affects businesses in these areas that employ over 100 people; that's roughly 28,000 employers and 11 to 12 million employees.
- Affordable videoconferencing, ISDN, and ATM are expected to fuel the growth of telecommuting.
- The "cost per seat" for videoconferencing is about $5,000 and is expected to decrease 25 to 30 percent annually.
- The downside: Out of sight, out of mind. Telecommuters don't engage in informal networking.
- The Telecommuting Advisory Council (619-688-3258) is a nationwide clearinghouse of telecommuting information.

Photography by Ken Burris

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CIRCLE 038 ON READER SERVICE CARD

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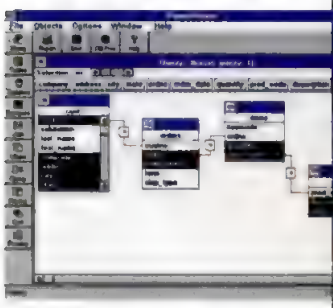

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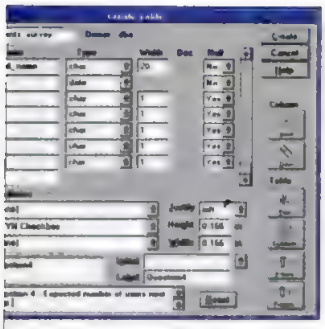

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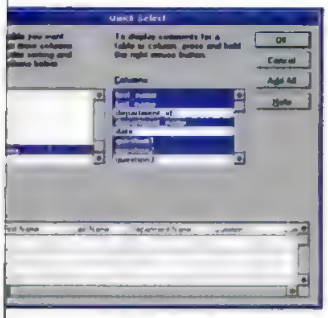

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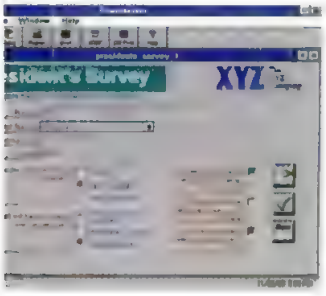

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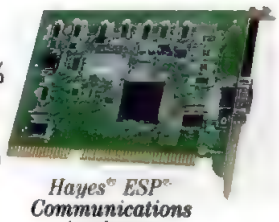

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CIRCLE 933 ON READER SERVICE CARD

First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

Another Way to Distribute Digital Paper

Common Ground Stacks Up Well Against Acrobat

BY LORI GRUNIN

DigitalPaper, the term No Hands Software uses to describe the technology underlying its Common Ground for Windows ($189.95), exactly describes the company's goal for the product—a goal Common Ground not only successfully attains but manages to do at a more reasonable cost than its main competitor, Adobe Acrobat.

With Common Ground, you can turn any document into a binary file that can be searched, viewed, and printed by any PC or Macintosh user, provided that the user has either Common Ground or the miniviewer that can be included with the file. The miniviewer—which supports only viewing and printing and adds about 130K—is royalty-free for small-scale distribution, but there's a licensing fee of $500 a year for mass distribution. Combining a binary file with the miniviewer creates a standalone executable application.

DUPLICATE: *Common Ground for Windows accurately reproduces any typeface.*

Rather than embedding fonts, as Farallon's Replica does, or substituting them, as Acrobat does, Common Ground actually generates bitmaps of all the characters used in the document (at 72, 96, 100, and 300 dots per inch). The Common Ground file looks exactly like the original document.

The program retains the text- and font-formatting information and—uniquely—lets you save the file out into a variety of word processor formats. (You can lock the file against saving, copying to the clipboard, and printing.) Keep in mind, though, that while Common Ground maintains character formatting, it

Continues on page 38

A PC for the "Techno-Critical User"

Dell's OmniPlex Pentium Starts at $3,599

BY DON WILLMOTT

Dell Computer Corp. has been on a roll lately. When *PC Magazine* evaluated 191 486-based systems late last year ("486 Buyers' Guide," December 7, 1993), its ISA-based Dell OptiPlex MXV was one of only two systems to get the Editors' Choice nod. Now, Dell's first EISA-based Pentium systems, those units comprising the OmniPlex family (not to be confused with the OptiPlex family), prove to be equally interesting and compelling systems.

Though there are cheaper ways to get a Pentium system from Dell (the relatively inexpensive line of Dell Dimension PCs includes a Pentium model called the Dell XPS P60, which is targeted at small-business and home-office users), the OmniPlex system is meant for what Dell calls the "techno-critical" user, which, loosely translated, seems to mean the corporate power user.

MIDSIZE: *The Dell OmniPlex 566 is destined for corporate desktops.*

TWO MODELS

There are two OmniPlex models. The 60-MHz, Pentium-based Model 560 starts at $3,599 and comes with 8MB of RAM, a 256K write-back cache, a 120MB hard disk, one floppy disk drive, 1MB of VRAM, and a Super VGA monitor. The 66-MHz version, called the Model 566, starts at $4,099. The realistically equipped Model 566 system that we received for testing included 32MB of RAM, a dual-media floppy disk drive, a dual-speed CD-ROM drive, a 535MB SCSI hard disk, a 1MB VRAM upgrade, and a 15-inch Dell UltraScan monitor. The total cost was $6,967.

This is no gigantic tower system designed to be used as a LAN server. The midsize OmniPlex is proof that Pentium-based machines are going to waste no time in making the trip to corporate desktops, and with heavy-duty specs.

For example, while the majority of Pentium systems that

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Photography by Thom O'Connor

Common Ground

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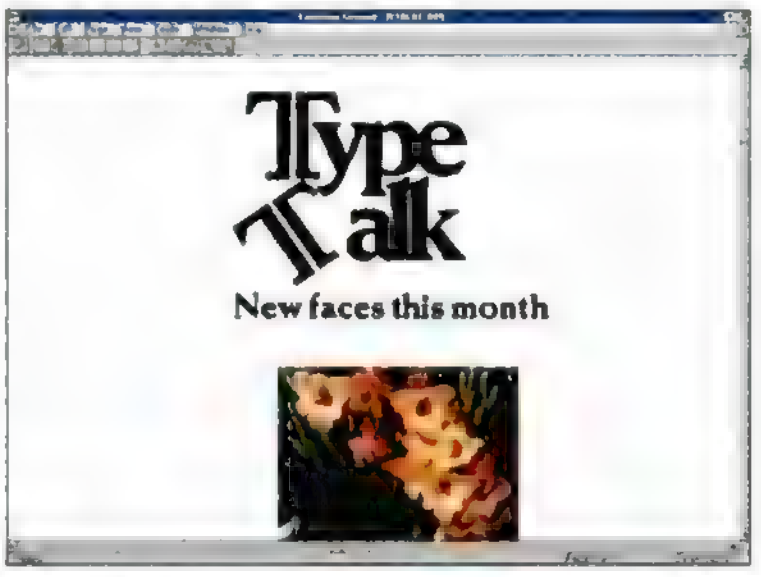
knows nothing about paragraph formatting; files saved out to other formats have hard returns at the end of every line, and spaces between paragraphs are lost.

When you are saving, the built-in Panose font-matching system lets you remap typefaces that do not exist on your system. Common Ground can also act as an OLE 2.0 server, and it supports drag-and-drop embedding into other applications' documents.



JAGGIES: *At 200 percent zoom, text starts to appear jagged because the program uses the low-resolution information.*

HIGH RES: *At 400 percent zoom, the letterspacing in the logo appears correctly, and the text is sharp.*

MAKIN' IT

Common Ground consists of two interlinked parts: CG Maker and CG ZScript. The Maker is used to generate files from most standard text-based documents; the ZScript extension, based on Zenographics' ZScript PostScript-compatible interpreter, handles publications that include Encapsulated PostScript graphics or files created by PostScript-optimized applications such as Quark XPress. You don't need to use the extension for documents with Type 1 fonts but no PostScript graphics. Unlike Adobe's Acrobat Distiller, an $895 add-on to its Exchange product, the ZScript extension ships as part of the basic product.

As with other products of this type, Common Ground does most of its visible work as a printer driver. Printing to the Maker from an application automatically translates the document into the Windows GDI primitives that the product uses to display a file. Options include JPEG compression quality for bitmaps (the product uses Storm Technology's JPEG compressor). You can choose to include images at screen resolutions rather than at their original resolutions.

PostScript-bearing documents, on the other hand, can be translated in one of two ways. As with the Maker, you can target the ZScript PostScript driver, which spools a .ZPS temp file and then launches the ZScript server. The ZScript server spawns the Maker, which translates the .ZPS file into the final .DP format.

Alternatively, you can use the ZScript server as a standalone application, which lets it process PostScript files that have been printed to disk. This is handy for converting files from platforms that currently lack Common Ground support, such as DOS and Unix. (No Hands Software expects to ship versions for these platforms during the first half of this year.)

KEEPING IN CHARACTER

For compactness, Common Ground rasterizes each character only on the first encounter and keeps a database of locations for subsequent occurrences. As a result of this process, the product generates smaller files when you use fewer typefaces and sizes. On a test file using the entire alphabet and numerals, adding an extra typeface added about 4K to the original file, while changing the point size of a section in the original added about 5K.

The product manages to produce acceptably small files. A seven-page, text-only Microsoft Word for Windows document with two typefaces was about 89K, although the equivalent document generated by Acrobat was only about 43K. Neither seemed appreciably faster than the other while scrolling pages.

In general, using bitmaps can sometimes pose problems, such as overlapping characters at a zoom other than 1:1. Common Ground avoids this problem by reading in the kerning and tracking information from all the fonts on the originating system during installation and then using that data to rasterize the fonts for all zooms properly.

Any document-specific adjustments you may have made, however (such as decreasing the letterspacing between two characters in a headline or .EPS-format logo), are captured only in the 300 dpi version. The only time those elements will look right is when they're zoomed out to 400 percent. Common Ground uses the 300-dpi information at this zoom level, but it uses the 96-dpi information for 50, 100, and 200 percent—or when you print.

Also, since Common Ground uses the low-resolution information for the 200 percent zoom, the resultant document looks quite pixellated. This is a problem when running on relatively high-resolution displays (1,024-by-768 and up), at which 100 percent zoom won't be a comfortable viewing size for many people. A forthcoming upgrade will fix this.

In fact, the only significant problem we had were conflicts with the driver for the ATI Graphics Ultra Pro (Version 2.2), which caused the ZScript server to crash when we opted to save bitmaps at screen resolution. A bad .EPS graphic from Micrografx Designer caused severe text display artifacts, although it printed properly. The same file, on the other hand, sank the Acrobat Distiller.

The program still lacks hyperlinks or any tools for navigating long documents, and graphics can be cut only to the Clipboard and only as bitmaps, which gives Acrobat an edge in these areas.

Nevertheless, with Common Ground, No Hands Software seems to have found a nice combination of functionality, ease of use, and price that should satisfy users who need to distribute small-to-medium–size documents electronically.

• List Price: *Common Ground for Windows, $189.95; introductory price, $99 through July 31, 1994.* Requires: *2MB RAM (4MB required for PostScript extension, or for use under Microsoft Windows for Workgroups), 2.5MB hard disk space, Microsoft Windows 3.1. No Hands Software Inc., 1301 Shoreway Rd., #220, Belmont, CA 94002; 800-598-3821, 415-802-5800; fax, 415-593-6868.*

Circle 428 on reader service card

FIRST LOOKS PLUS

From February 7 through February 11, you can go online to download a fully working trial version of Common Ground or to discuss the program with Lori Grunin and No Hand's cofounder and vice president of engineering, Nick Gault. Type GO EXEC from any CompuServe ! prompt.

Dell OmniPlex

CONTINUED FROM PAGE 37

have been tested by PC Labs so far accommodate a maximum of 128MB of RAM, the OmniPlex doesn't stop there. By including six SIMM (single in-line memory module) sockets on the motherboard, instead of the more typical four, the OmniPlex can take a total of 192K of RAM.

Built-in Fast SCSI-II is another strong, high-end addition, and all drivers are included. There are a total of three externally accessible drive bays.

The system includes five expansion slots that stack sideways, putting the cards parallel to the motherboard. Three of the slots are EISA-based, while the other two are EISA/PCI-based. All the expansion slots are located on a riser board that can be removed.

The idea of providing two dual-architecture slots is a good one. Though PCI (Peripheral Component Interconnect) expansion cards are being much discussed and eagerly anticipated, they haven't yet become widely available on the market at reasonable prices. By putting EISA and PCI together in the space of one expansion slot, the OmniPlex doesn't force you to waste slots while you wait for future components to upgrade the system. (In the photo, the combination slots are black and white, toward the top of the stack of slots.)

The Pentium chip sits on the motherboard under a big silver heat sink that has more surface area to dissipate heat than most we've seen so far. The microprocessor has its own fan to keep it cool (the warm air comes out the front of the chassis), and there's a processor thermal shutdown feature to help prevent overheating disasters.

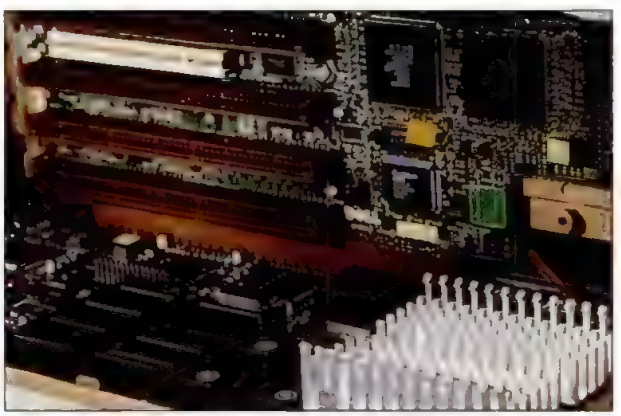
PENTIUM PERFORMANCE

With its 64-bit processor and memory design, and with PCI providing fast I/O, you'd expect this system to perform well, especially with the optional SCSI hard disk and VRAM upgrade that were installed in the unit we tested.

Fortunately, the OmniPlex didn't disappoint in testing. Its benchmark test results were good across the board. On our PC Bench 8.0 tests, the OmniPlex's processor score exceeded the average processor score of previously tested 66-MHz Pentium systems. The ATI-based video subsystem was above average, too, as was the disk score (though by less of a margin). The DOSmark score was an excellent 1,039.42.

In WinBench 4.0 testing, the OmniPlex earned a Graphics WinMark score of 19.6 millions of pixels per second, but its Disk WinMark score was a little below average, surprising considering the Seagate drive's fast SCSI interface.

When compared with the 11 Pentium systems PC Magazine Labs recently tested (see "Pentium: The Second Wave," January 25, 1994), only the Gateway 2000 P5-60 had a better video score, and only the HiQ P66 Pentium Graphics Ultra Station yielded a better Graphics WinMark score. That evaluation showed that a well-designed 60-MHz system could sometimes outperform a 66-MHz model, but in the case of the OmniPlex, the 66-MHz processor pays off handsomely for processor-intensive computing.



INSIDE THE OMNIPLEX: *There are five expansion slots, two of which can handle either EISA or PCI cards.*

SERVICE AND SUPPORT

Each of the OmniPlex models come with a one-year warranty, with next-day, on-site service provided through BancTec Service Corp. OS/2 fans should note that Dell is also now offering optional factory installation of OS/2 2.1.

With Intel promising huge production runs of Pentium chips in 1994, more and more corporate PC users will be trading up to Pentium this year. Among an early group of good choices, the OmniPlex Model 566 is one of the best.

• List price: *Dell OmniPlex 560, $3,599; Dell OmniPlex 566, $4,099. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-728-4238.*

Circle 430 on reader service card

The Pentium Power Publisher

Last year, Dell teamed up with SuperMac and Adobe to form the Dell Power Publishing Alliance. The group created pricey turnkey workstations designed specifically for desktop publishing. All the included software and hardware was strictly top drawer (see First Looks, October 26, 1993).

Basing the Power Publishing Superstation on a 486DX2/66 processor was a good idea, but building one around a 60- or 66-MHz Pentium CPU is even better. The Dell-Adobe-SuperMac troika is back with two Pentium Power Publishing OmniPlex models: the $9,495 OmniPlex 560 and the $9,995 OmniPlex 566.

Both come with 32MB of RAM upgradable to 192MB, a 256K direct write-back cache, a 700MB SCSI hard disk, a 17-inch SuperMatch monitor, and a SuperMatch Thunder/24 graphics board with color calibrator.

On the software side, Adobe takes over. You get Photoshop for Windows 2.5, Illustrator for Windows 4.0, Adobe Type Manager, and your choice of PageMaker 5.0 or QuarkXPress for Windows 3.12, the two leading professional desktop publishing packages. These systems aren't for everyone, but if you're in the graphics or desktop publishing business, you'll find this a compelling bundle, especially when you compare it with Macintosh Quadra models that cost more than $10,000.—*DW*

Benchmark Tests: Dell OmniPlex 566

The 66-MHz Pentium-based Dell OmniPlex 566 did well across the board on our benchmark tests, especially on our video test.

We used PC Magazine Labs' PC Bench 8.0 and WinBench 4.0 to test the Dell OmniPlex 566's performance.

Higher scores represent better performance	PC Bench 8.0 Processor (score)	PC Bench 8.0 Video (score)	PC Bench 8.0 Disk (score)	PC Bench 8.0 DOSmark (score)	WinBench 4.0 Graphics WinMark (millions of pixels per second)	WinBench 4.0 Disk WinMark (score)
Dell OmniPlex 566	80.5	3,518	1,468	1,039.4	19.6	1,330
66-MHz Pentium average	78.8	1,828	1,420	838.7	21.8	1,418

Programming Languages

Borland C++ 4.0: Tools for Building 16- and 32-Bit Apps

BY RICHARD HALE SHAW

After a long hiatus, Borland International has finally released its latest C++ development environment, Borland C++ 4.0 for DOS, Windows, and Windows NT. Featuring powerful code-generating "experts" and a multitarget project manager, this $499 compiler package can generate both 16- and 32-bit Windows applications and has a rich, graphical environment with an integrated debugger and browser. With a redesigned application framework and support for Visual Basic Extensions (VBXs), Borland C++ 4.0 is a formidable 16-bit development environment, but there are chinks in its 32-bit armor.

Borland C++ 4.0 strongly endorses the Windows programming paradigm that was first advanced by Microsoft Visual C++. It has specialized dialogs called Experts for generating and modifying programs derived from Borland's Object Windows Library (OWL), Version 2.0—the latest version of Borland's application framework. For example, AppExpert lets you create both multiple- and single-document-interface applications with integrated menus, toolbars, and status bars, and features built-in support for printing, print preview, and help.

More flexible than Microsoft Visual C++'s AppWizard, AppExpert lets you designate custom controls or 3-D controls in the application, which startup options to use, and the main window's title-bar content and background color.

NEW PROJECT MANAGER

Once you've generated the application, Borland C++ 4.0's Project Manager window will display the project in an outline tree display reminiscent of the File Manager's directory display; the outline headers are project targets (.EXE files or DLLs), and subheaders are their dependencies (.CPP, .DEF, and .RES files) and subdependencies (header files and RC files). You can create an application composed of multiple targets or even an .EXE file with the same name and dependencies but different build options.

Borland has made considerable use of the right-mouse-button–invoked property inspector menu that has become popular in a number of Windows applications. By right-clicking an item in the Project Manager, you can use the property inspector menu to run the target program, view a selected source file, or add new modules to the application.

SLOW COMPILER

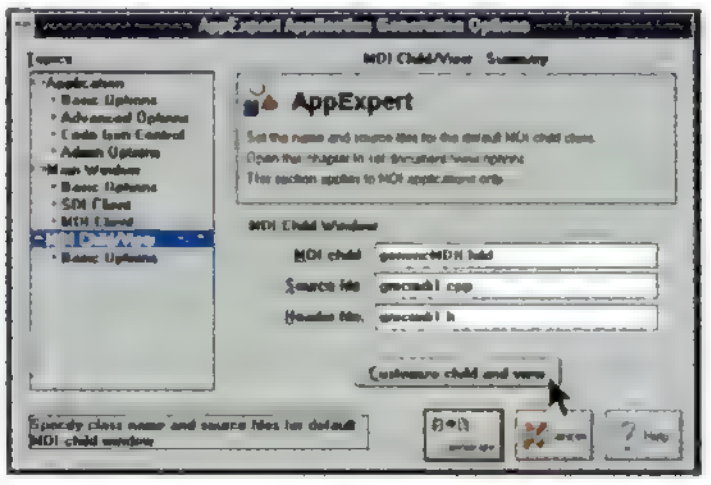
While Borland C++ 4.0 will automatically compile the generated help files when it compiles an application, the overall compilation process is too slow because of an anachronism that dates back to Borland's first C environment: The compiler spends too much time displaying the number of lines compiled in each file and in the project as a whole. The IDE (integrated development environment) should let you disable it via an option, but it doesn't.

Also rooted in the past is Borland's Resource Workshop. Once a leading tool for editing dialogs, menus, icons, and bitmaps, Resource Workshop has hardly changed. It's too modal and lacks the intuitive, drag-and-drop approach of Microsoft Visual C++'s AppStudio.

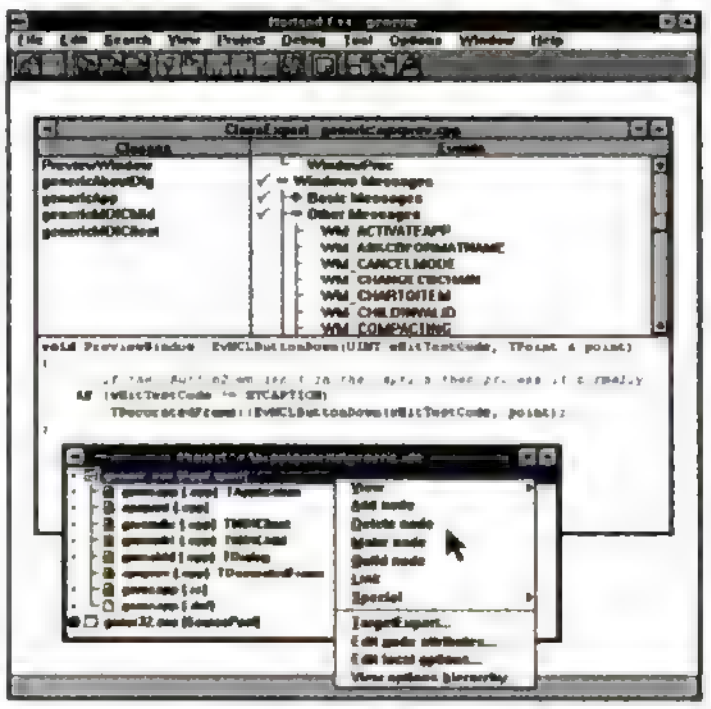
On the positive side, Borland has redesigned its IDE. It's now a rich graphical environment with an integrated graphical browser and debugger and the look of an OLE application. As you switch from an editor window to a debugger window to a project window, the menus and toolbars change to display the appropriate commands and icons. You can use the debugger to step through editor windows and edit code in debugging windows. All editor windows, including the ClassWizard editor pane, have the functionality of Borland's BRIEF editor.

Borland has rewritten its application framework, OWL. Version 2.0 is more flexible and is portable to both 16- and 32-bit Windows. A porting tool, OWLCVT, will convert most of your OWL 1.0 code to OWL 2.0. Then you can take advantage of new OWL classes that support toolbars, status bars, small caption bars, sliders, gauges, and bitmaps. OWL 2.0 now encapsulates Windows GDI and Win32 threading and synchronization objects, so you can rely more on the framework and less on calling the Windows API (application programming interface).

While Borland C++ 4.0 is the first serious competition for Microsoft Visual C++, it lacks integrated database and OLE support and does best when you're writing 16-bit applications. If you're going to work on Windows NT or Chicago applications, stick with Microsoft Visual C++, but if you're building 16-bit applications, especially those that make use of VBXs and don't require OLE or database support, you'll find Borland C++ 4.0 an exceptional tool. □



APPEXPERT: *You get a number of options for generating an application whose C++ classes are derived from OWL 2.0.*



CLASSEXPERT: *The Project Manager can handle multitarget projects and uses an outline display.*

FACT FILE

Borland C++ 4.0 for DOS, Windows, and Windows NT

Borland International Inc., 100 Borland Way, Scotts Valley, CA 95066; 800-331-0877, 408-431-1000; fax, 408-439-9103

List price: $499

Requires: 4MB RAM, 20MB hard disk (50MB recommended), DOS 4.01 or later, Microsoft Windows 3.1, Microsoft Windows NT

In short: Borland C++ 4.0 is a powerful new environment for Windows development, despite deficiencies in its resource editor

422 ON READER SERVICE CARD

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CIRCLE 097 ON READER SERVICE CARD

For Your Information.

Image Editing

Kai's Power Tools: Play with Your Graphics

BY LUISA SIMONE

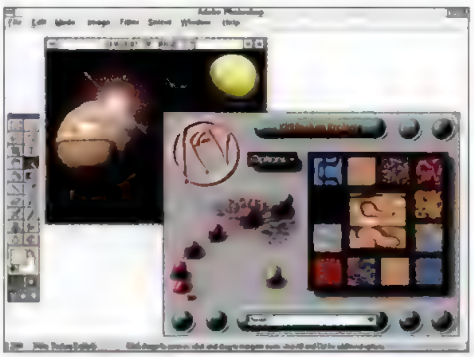
Kai's Power Tools for Windows ($199), from HSC Software, works in conjunction with image-editing programs, taking advantage of the Adobe Plug-in specification to become, quite literally, a part of your favorite image editor.

Widespread support of the Adobe spec means that you can use these 33 filters—which build upon and extend standard image-editing functions—with a number of different products, including Adobe Photoshop, Aldus PhotoStyler, Fractal Design Painter, and Micrografx's Picture Publisher.

The most accessible parts of KPT are the 25 straightforward filters—such as Diffuse More, Find Edges, Invert, and Noise—that appear as simple one-click menu items. Thanks to the program's advanced algorithms, they often produce superior results. For example, most image-editing programs include a Spherize filter that can create the illusion of a three-dimensional globe. KPT's version—Glass Lens—renders a much more realistic sphere, complete with user-definable highlights and ray-traced shadows.

If KPT offered only these filters, it would face stiff competition from Aldus Gallery Effects—a two-volume collection of special-effects filters that (unlike KPT) can switch between standalone and plug-in status and provide previews. KPT, however, stakes out new territory by providing a second set of filters that can create wholly new textural images. Pop-up windows transport you into KPT's universe, where you can play with algorithms that create sophisticated gradients, mutated textures, and traditional Mandelbrot or Julia set fractals.

The operative word here is *play*. KPT's user interface encourages artistic exploration by avoiding standard menus and radio buttons in favor of a more organic working method. The Texture Explorer, for example, uses a tree—yes, a tree—to control the degree of random change for each new generation of patterns. Choosing an option at root level produces modest mutations, while choosing an option in the highest branches results in radical mutations.



DAZZLING: *Unlimited artistic possibilities.*

If you're willing to adapt to KPT's unconventional interface, you'll find that the results—which include transparency effects, gradients along a path, and procedural blends (where textures are mapped onto an image according to light and dark values)—are worth the effort. Business users will feel immediately comfortable with KPT's one-step filters, while artists will appreciate how this program can transform special-effects work into creative play.

• List price: *Kai's Power Tools for Windows, $199.* Requires: *4MB RAM, 8MB hard disk space, Microsoft Windows 3.1. HSC Software, 1661 Lincoln Blvd., Santa Monica, CA 90404; 310-392-8441.*

Circle 432 on reader service card

Fonts

Font-o-matic's Effects Create Outrageous Type

BY EDWARD MENDELSON

When Font-o-matic is done applying special effects to your fonts, you probably won't recognize them. Altsys Corp.'s $59.95 Windows utility takes any normal TrueType or PostScript font in your system and, like a mad scientist in a horror film, converts it into a font covered with, say, cow spots, cactus spikes, or wavy bumps.

Font-o-matic can also slice a font into stripes, drill it with Swiss-cheese holes, convert it into the font style used on college sweatshirts, or take a large bite out of every character.

Font-o-matic's interface displays a large image of one letter in the current font, a row of buttons that turn on special effects, and a row of sliders that control the effects. If you select the Cactus effect, for example, the sliders let you control the number, length, and width of the spikes that the program will add to your current font.

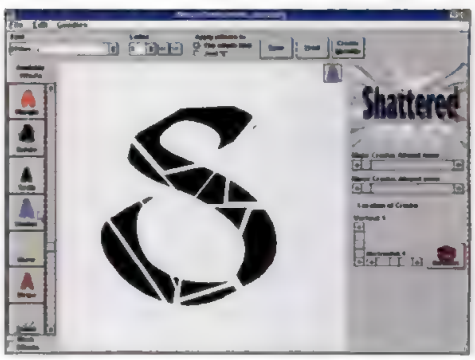
You can import both TrueType and PostScript Type 1 fonts, but the program saves modified fonts in TrueType format only, with an option that installs them into Windows. Saving a font typically takes 5 minutes on a 66-MHz 486 machine—and that's with the Fast-save option turned on. Fonts with the most complex effects may not print unless you use a slower option, which cleans up the font outlines and almost doubles the time needed for saving. If you "stack" multiple effects in a single font, the program really slows down.

Font-o-matic plays high-intensity rock music through your sound card while it works, and if you don't want sound, you have to switch it off whenever you run the program.

Most effects won't print clearly at less than around 50 points, partly because the resulting fonts are so complex and partly because fonts modified by the program lose all output-improving "hints" applied by the original designer. The package includes seven sample fonts, most of which are excellent.

Font-o-matic is the first font program that produces outrageous effects—instead of traditional effects like simple shadows. If you want outrageous-looking text, nothing adds as much outrage as Font-o-matic.

• List price: *Font-o-matic, $59.95.* Requires: *4MB RAM, 3MB hard disk space, Microsoft Windows 3.1. Altsys Corp., 269 W. Renner Pkwy., Richardson, TX 75080; 800-477-2131, 214-680-2060; fax 214-680-0537.*



SHATTERING: *Font-o-matic breaks up fonts—or creates almost any other effect you like.*

Circle 429 on reader service card

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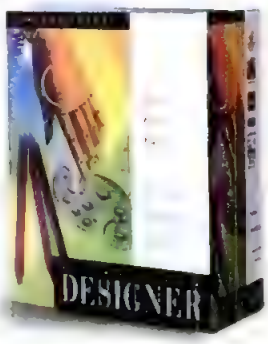

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CIRCLE 361 ON READER SERVICE CARD

Communications

Delrina Combines Comm Software with WinFax

BY CAROL ELLISON

Delrina, the maker of WinFax PRO, packages a bit of the old and a bit of the borrowed in a new communications offering that marries its top-selling fax software, WinFax PRO, with a comm program called WinComm PRO in the $179 Delrina Communications Suite.

The suite, one of the finest unions of comm products found in one box, resolves the problem of port contention for users who want to run WinFax PRO in receive mode and still have their modems available for dial-out terminal communications. WinComm is Delrina's make-over of Hilgraeve's HyperAccess for Windows. Delrina purchased the HyperAccess source code last year, tweaked modem handling so that WinComm, when loaded, automatically reinitializes the modem for terminal communications and, when exited, automatically reinitializes for fax reception.

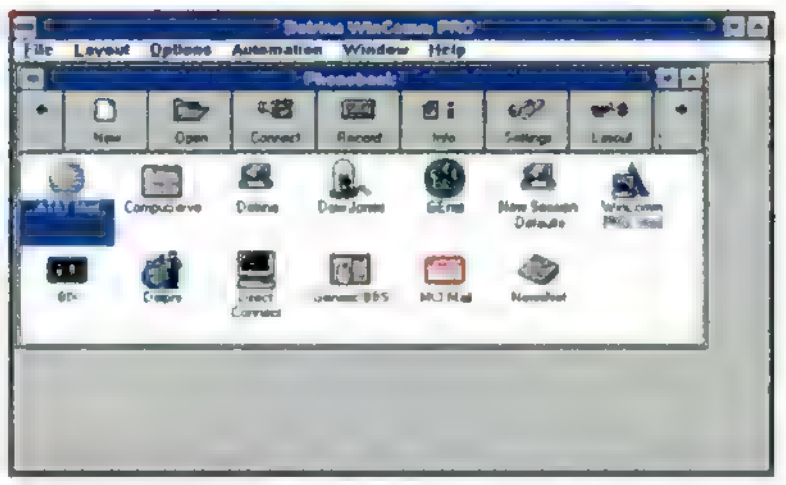
Delrina also changed the user interface to make it more like WinFax PRO's. So while the bundle breaks little new ground in program code, it solves big problems for users who run fax and terminal communications concurrently.

The suite bundles WinFax PRO and WinComm as separate programs, much like the office productivity suites from Borland, Lotus, and Microsoft. Each program has its own installation routine, and each is launched from its own icon.

The suite also includes front-end software for the Delrina Fax Broadcast Service and a $50 credit on its price. With it, you can set up phone-book entries that will broadcast a single fax to hundreds of fax numbers.

WinComm uses a friendly interface. A generous number of screen fonts are available for your communications, and the program supports all nonproportional fonts installed on your system.

A backscroll buffer captures up to 5,000 lines of a communications session. You can cut and paste from the buffer and use it to review received e-mail messages as you answer them. Drag-and-drop is nicely implemented, letting you drag text from windows and files into your messages.



DIAL UP: *WinComm PRO can be customized to set up phone book entries as icons.*

The Delrina Communications Suite is aggressively priced and packs extraordinary value. WinFax PRO users who want communications can upgrade to the Communications Suite for $49. A $69 competitive upgrade is also available.

• List price: *Delrina Communications Suite, $179.* Requires: *4MB RAM, 6MB hard disk space, Microsoft Windows 3.1. Delrina Corp., 6830 Via Del Oro, #240, San Jose, CA 95119; 800-268-6082, 408-363-2345; fax, 408-363-2340.*

Circle 421 on reader service card

Communications

TurboCom/2: A Must-Have for Windows

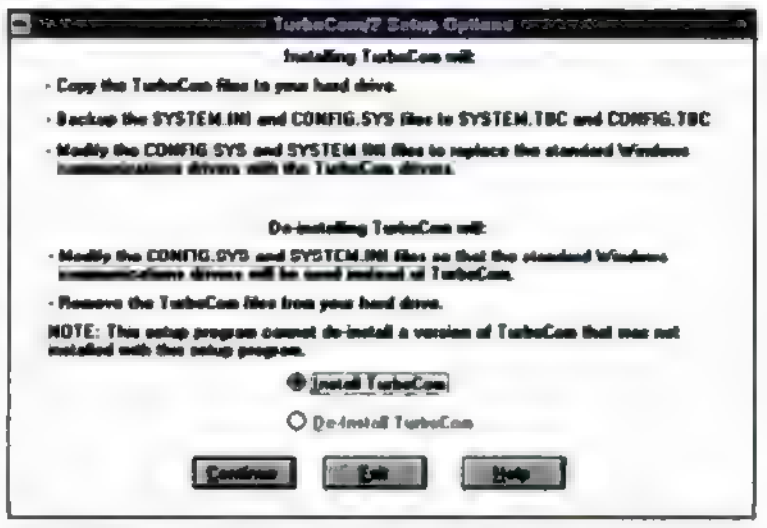
BY RICK AYRE

TurboCom, Pacific CommWare's replacement for Microsoft Windows 3.0's COMM.DRV communications driver, was so good that some people said it was nothing short of a software miracle. TurboCom/2, which replaces the driver in Windows 3.1, is a better miracle.

TurboCom always offered dependable data throughput of up to 115.2 kilobits per second. You used it to download data in the background at high speeds, even on slow 386 machines.

The $29.95 TurboCom/2 has new interrupt options, so you are able to choose the serial-port configuration that works best for you. It supports true IRQ sharing—even on ISA-based systems—assuming you have a serial board that offers that capability. It also has additional support for DOS communications programs, allowing programs that don't understand the 16550 UART to use its interrupts and buffer.

Windows 3.1 includes support for the 16550 UART, but only for native Windows applications. A lot of people still use DOS applications under Windows, particularly people who have come to know and love a good DOS communications program.



DE-INSTALL: *Unusual for this kind of driver.*

TurboCom/2 improves Windows communications in two ways. It uses interrupts more efficiently, and its support for the 16550 UART lets Windows users achieve reliable high-speed communications throughput.

We tested TurboCom/2 on two systems, a 20-MHz 386 and a 33-MHz 486, both equipped with the 16550 UART. Using TapCIS in a Windows DOS session and a 14.4-Kbps modem, we downloaded all of the messages from one ZiffNet Forum.

Neither one of the computers could finish the task successfully with the Windows 3.1 COMM.DRV installed. The 386 system began the download and then aborted the session and issued a buffer overrun error message. The 486 completed the download but announced at the end that 10 percent of the data had been lost. Both computers completed the task successfully without errors once TurboCom/2 was installed.

TurboCom/2 is a must-have if you depend on serial communications or just want to communicate reliably. As modems get faster (and V.Fast *is* on the horizon), TurboCom/2 will be absolutely essential.

• List price: *TurboCom/2, $29.95.* Requires: *Microsoft Windows 3.1. Pacific CommWare, 180 Beacon Hill Ln., Ashland OR 97520; 800-856-3818, 503-482-2744.*

Circle 433 on reader service card

FIRST LOOKS PLUS

From February 14 through February 18 you can go online to discuss TurboCom/2 with Rick Ayre and Pacific CommWare founder and president John Loram. Type GO EXEC from any CompuServe prompt.

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RADARSAT is a low orbit satellite that will take radar images of the earth. The engineering, design and manufacturing stages for this $300 million project are being scheduled using Primavera Project Planner® (P3®).

The Autobahn, Germany

P3 will be used to rebuild the Autobahn in what was formerly East Germany. Both contractors and subcontractors are standardizing on Primavera for this project.

New Hong Kong Airport, Hong Kong

This $20 billion airport construction project also includes the construction of highways, an airport rail system, a suspension bridge and a cable stay bridge. Projected completion is June 1997.

Kuala Lumpur Tower, Malaysia

This $100 million, 420-meter tower will be the third tallest communication tower in the world. Estimated completion date is 1996.

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CIRCLE 148 ON READER SERVICE CARD

Multimedia

Memphis: Equal Parts Performance and Style

BY MARK BROWNSTEIN

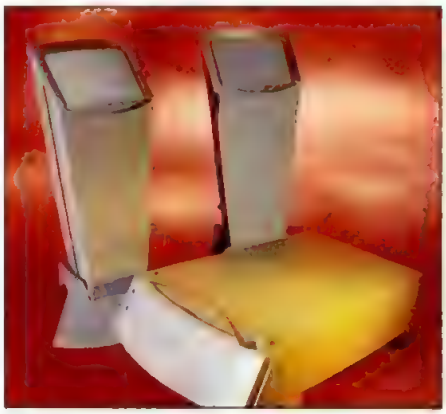
You can buy all kinds of multimedia upgrade kits that include a sound board, a CD-ROM drive and controller, speakers, and CD-ROMs, but Media Vision's $995 multimedia upgrade system, Memphis, really breaks the mold.

The first thing you notice is the unit's unconventional appearance. Taking a cue from the Milan-based design consortium for which it is named, the Memphis system features three bold, somewhat playful geometric shapes.

The squat main cabinet contains the CD-ROM drive. Flip down the front panel and you find the drive bay, along with various controls including volume and CD-track selection. The speakers seem to do more than just sit on top of a surface, they look as if they're growing out of it. They can either remain attached to the main unit (horizontally or vertically) or be separated for better stereo sound.

The individual components in Memphis are equally strong. The special version of the 16-bit Media Vision Pro AudioSpectrum sound board around which the package is built is a good performer, and the double-speed CD-ROM drive provides MPC-compliant performance. A small CD-ROM multimedia software bundle rounds out the package.

The Memphis system is mobile, too. You can detach it from its connection to the computer and use it as a standalone CD player. And when it's connected to the computer, you don't need to load software to play CDs.



STYLISH: *A new look for multimedia.*

The Pro AudioSpectrum board provides the computer interface as well as the connection to Memphis. It acts as both a SCSI controller and a Creative Labs Sound Blaster–compatible sound board. You can also use it to control other SCSI devices on your system.

Memphis is a good option if your system is filled up inside and you don't have room for an internal CD-ROM drive. It's also a good choice if you really don't like the look of most external CD-ROM drives.

Memphis may not be the cheapest multimedia upgrade product, but in view of its double-speed drive, its portability, and its unconventional looks, it should certainly appeal to the multimedia fan with a taste for the unusual.

• List price: *Memphis, $995. Media Vision, 47300 Bayside Pkwy., Fremont, CA 94538; 800-845-5870, 510-770-8600; fax, 510-770-9592.* Requires: *2MB RAM, 10MB hard disk space, Microsoft Windows 3.1, 16-bit expansion slot.*

Circle 419 on reader service card

Contact Management

TeleMagic Includes Screen Designer

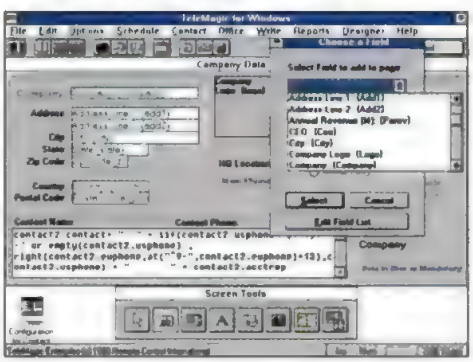
BY DAVID DEJEAN

TeleMagic for Windows breaks away from the one-size-fits-all approach typical of contact management software and attempts to become a full-blown programmable system.

Many contact managers have been marked by their inability to communicate the data they collect and their inability to be customized. And with their cluttered, hard-to-use interfaces, they also lack ease of use.

The $499 TeleMagic for Windows tackles these problems by providing the Windows interface, network support, and a high degree of customization control. Remote Control International has learned its lessons from previous versions of TeleMagic for DOS, Macintosh, and AS/400 platforms.

The program's basic structure splits in two parts: a good calendar/scheduler called the Activity Manager and the Contact Manager itself, which creates three related levels of data (the example shipped with the product calls them "Company," "Contact," and "Contract Detail," but they could just as easily be "Team," "Member," and "Assignment"). There is a core set of reports and functions, including some support for printing, mail-merge with Word for Windows or Ami Pro documents, and good import/export.



CUSTOMIZE: *TeleMagic's screen designer provides control over the interface.*

Beyond that, the available data fields, their arrangement into screens, and the design of custom reports are all user-definable to an extent that few contact managers attempt.

TeleMagic also works with NetBIOS-compatible networks, including NetWare and LANtastic, and doesn't require a dedicated server.

Windows itself is a big improvement. The only major element missing is an adequate toolset for building customized programs. Hence creating a customized data screen isn't the direct screen-painting exercise it should be—which might be one reason TeleMagic is sold through consultants.

TeleMagic lacks other features that you might expect in a Windows app. It provides OLE support as a field type, for example, but won't allow you to paste graphics or worksheets into its note fields. And while you can configure TeleMagic to shell out to an external e-mail program, there's no direct support for creating, addressing, and sending e-mail or faxes.

• List price: *TeleMagic for Windows, single-user version, $499; 5-user LAN version, $1,299; additional 5-user pack, $500.* Requires: *4MB RAM (8MB recommended), 10MB hard disk space, Microsoft Windows 3.1. LAN version requires NetBIOS-compatible network. Remote Control International, 5928 Pascal Ct., #150, Carlsbad, CA 92008; 800-835-6244, 619-431-4000; fax, 619-431-4006.*

Circle 420 on reader service card

Word Processing

Ami Pro for OS/2: Integrate Without Speed

BY EDWARD MENDELSON

Ami Pro 3.0 for OS/2 builds on the features and interface of Ami Pro 3.0 for Windows by adding tight integration with OS/2's WorkPlace Shell, but the first OS/2 version of Lotus' $495 word processor takes away the speed and reliability of the Windows version.

The interface of the OS/2 version offers virtually the same options as the Windows version, although it presents them on the tabbed pages of OS/2-style notebook menus. The OS/2 version uses the same file format as the Windows version, but doesn't have the Windows version's graphics and charting options. When you open a file with charts and graphics created by the Windows version, you can view, move, or delete them, but you can't modify them. OS/2 users get the same equation and table functions of the Windows version.

STARTING FROM SCRATCH

Because Lotus entirely rewrote the program code for the OS/2 version, you can now edit different parts of the same file in more than one window. The OS/2 version lets you specify multiple directories for documents, macros, and templates, so the program can automatically search on a network drive for files not found locally.

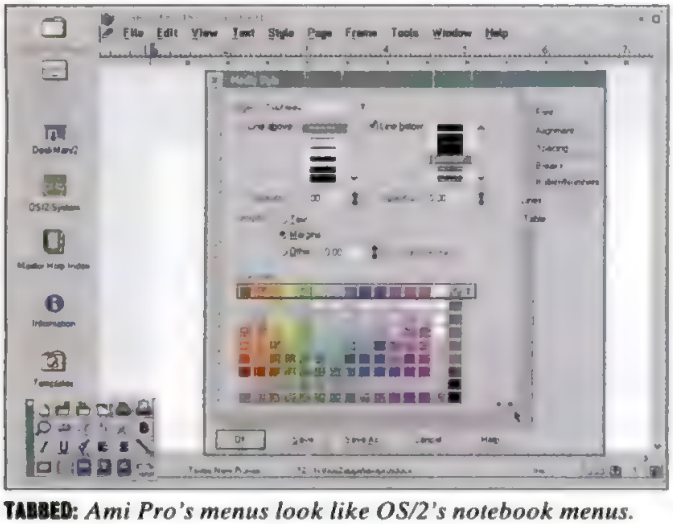
Integration with OS/2 includes the ability to drag files from Ami Pro to the desktop, although a bug in OS/2 sometimes causes Ami Pro to crash when you do this. A unique feature lets you use OS/2's REXX programming language in Ami Pro macros.

Lotus promises a maintenance release early in 1994 to fix Ami Pro's speed and reliability problems. The first release is painfully slow at importing and saving files. The Windows version running under OS/2 produces far better results. When tested with a 100K Microsoft Word for Windows file, the Windows version of Ami Pro imported it in 11 seconds, but the OS/2 version showed the clock icon for 10 minutes and then closed down without opening the file.

OS/2 users in search of a word processor can now choose between three native programs: DeScribe, WordPerfect 5.2 for OS/2 (which, as WordPerfect Corp. recently announced, will not be upgraded to a 6.0 version), and Ami Pro 3.0 for OS/2. Unless you need the OS/2-specific features of one of these native packages, you may get better results from a Windows word processor running in a seamless OS/2 window.

- List price: *Ami Pro 3.0 for OS/2, $495; upgrade, $129; upgrade from Windows version, $29.95 (without manual); $59.95 (with manual).* Requires: *8MB RAM (16MB recommended), 7MB hard disk space (17MB maximum install), OS/2, Version 2.0 or later. Lotus Development Corp., 1000 Abernathy Rd., #1700, Atlanta, GA 30328; 800-831-9679, 404-391-0011; fax, 404-698-7660.*

Circle 417 on reader service card



TABBED: *Ami Pro's menus look like OS/2's notebook menus.*

Power Management

PC Ener-g Saver Keeps Electricity Costs Down

BY BEN MYERS

It's not easy being green when you have older computer equipment that doesn't meet the Environmental Protection Agency's Energy Star guidelines. PC Green Technologies can help you out with a little (2- by 5- by 6-inch) white box that reduces the electrical consumption of the typical computer setup.

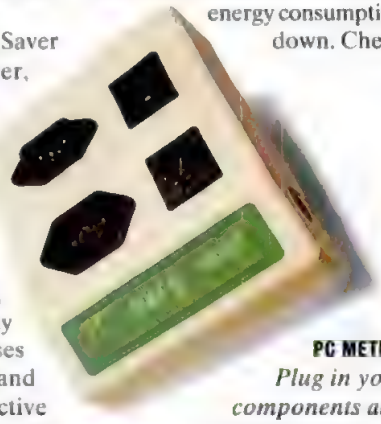
The $89.95 PC Ener-g Saver attaches to your computer, keyboard, monitor, and printer and includes its own good-looking power management software utility.

That utility, for both Windows and DOS, monitors the keyboard, mouse, and printer activity on your PC. When it senses that both the keyboard and the mouse have been inactive for a preset time period, it sends a message to the power control box to shut off the monitor. As soon as you move your mouse or press a key, the monitor springs back to life. Likewise, if the printer has been inactive for its user-defined time period, the software turns it off until you issue a print command. That action automatically restores power.

Both the small (2.5K) DOS TSR and the Windows modules have menus for you to set inactivity periods, for both monitor and printer, that conform to your work habits.

How much money can you save with the PC Ener-g Saver? That depends on a number of factors: the cost of electricity in your neighborhood, the amount of power drawn by your monitor and printer, and your patterns of computer usage.

Until the day when all PCs are "green," the PC Ener-g Saver is a cost-effective tool to keep energy consumption down. Check your electrical bills and the rated electrical wattage for your monitor and printer. If your equipment seems a little too power-hungry but you're not ready to replace any of it with more energy-efficient models, try the Ener-g Saver.



PC METER: *Plug in your components and monitor power use.*

- List price: *PC Ener-g Saver, $89.95.* Requires: *IBM PC/AT 5-pin keyboard connector and socket. PC Green Technologies Inc., 1 Centerpointe Dr., #210, La Palma, CA 90623; 800-984-7336, 714-228-2230; fax, 714-228-2239.*

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Video

Matrox's New MGA Cards: 64-Bit Speed for $599

BY JAMES KARNEY

Matrox Electronic Systems has upped the ante in the Windows graphics accelerator game, releasing a second series of true-color, 64-bit MGA (Matrox Graphics Architecture) graphics cards while most competitors are still bringing out their first editions. The first MGA Ultima (with 2MB of VRAM) won an Editors' Choice for its features and speed ("Pumping Pixels," December 7, 1993). That VL-Bus version processed 54 million pixels per second. The new cards, built for the PCI interface, outperform the original by a wide margin, processing up to 85.4 million pixels per second. To make the new cards even more attractive, Matrox has cut their prices. Some models have prices as low as $499.

A NEW DESIGN

The MGA chip has been redesigned, and now there are two versions: MGA I and MGA II. Both offer faster internal clock speeds than the original: 55 MHz, compared with 33 MHz. Like the original, they each feature BitBlts (bit-block transfers), pattern, and fill acceleration, plus full use of VRAM's 64-bit block write capability.

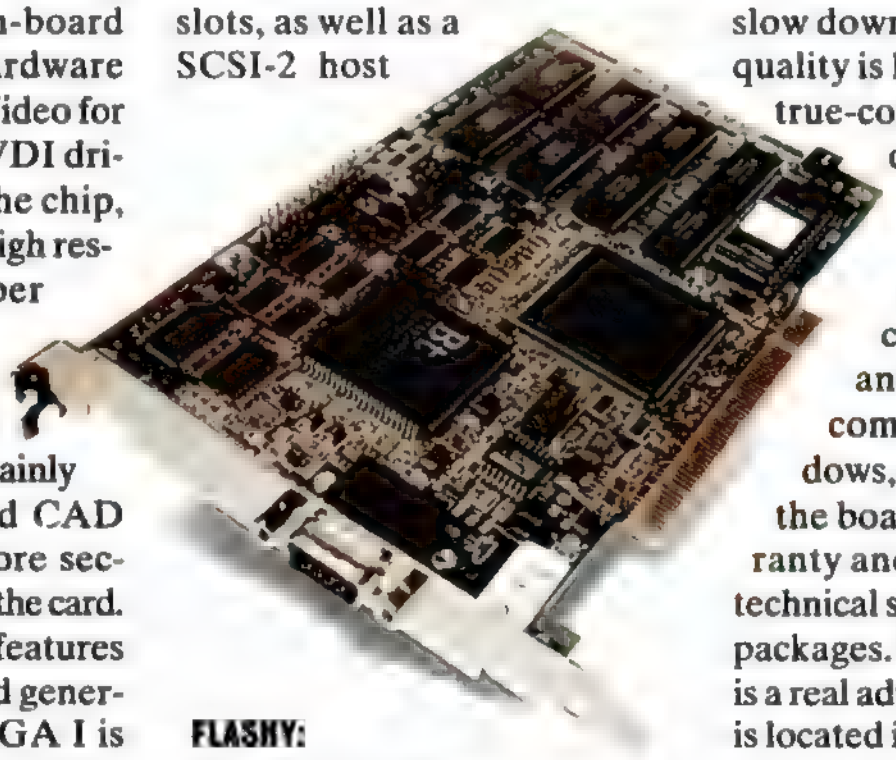
All MGA cards offer on-the-fly mode switching (without forcing you to exit Windows), virtual desktops, panning and zooming controls, anti-aliasing font technology, on-board VGA support, and hardware support for Microsoft Video for Windows. The Indeo VDI driver is built right into the chip, allowing animation in high resolutions at 30 frames per second.

The MGA I provides 3-D Gourand shading acceleration (mainly of interest to high-end CAD users) but requires more secondary com- ponents on the card. The MGA II lacks 3-D features but is less expensive and generates less heat. (The MGA I is equipped with a heat sink; the MGA II is not.) Various configurations are available for ISA, VL-Bus, PCI local-bus, and MCA interfaces.

There are nine models to choose from. Prices start at $499 for an Ultima 1MB ISA card that can produce 256 colors (8-bit) at 1,152-by-882 resolution or 16.7 million colors (24-bit) at 640-by-480. They range up to $1,699 for the Impression Pro, whose 8.5MB of VRAM can handle 24-bit operations all the way up to 1,280-by-1,024 resolution. Most of the MGA cards offer a maximum resolution of 1,600-by-1,200 with 256 colors.

EASY INSTALLATION

To see how well the new chip and interface stacked up against the original, we tested a $599 MGA II Ultima PCI with 2MB of VRAM. It supported 24-bit operation at 800-by-600 resolution, and 15-bit operation at 1,152-by-882 with 32,000 colors or 1,240-by-1,080 with 256 colors. We tested it on a 60-MHz Pentium PCI-based system with 24MB of RAM, a 256K external cache, DOS 6.2, and Windows 3.1. The system had three PCI slots and five ISA expansion slots, as well as a SCSI-2 host adapter and SCSI hard disk.



FLASHY: *The MGA Ultima delivers fast graphics.*

The PCI installation was very easy, much simpler than installing the ISA or VL-Bus versions of the MGA. Unlike the installation of those interfaces, there were no memory addresses to worry about. The only jumpers were for enabling or turning off the on-board VGA and for indicating the presence of an added 2MB of VRAM. Some 2MB models can be upgraded to hold a total of 4MB (a $300 option). We placed the card in a free PCI slot, booted the computer, and used the automatic setup routine on the drivers disk. It worked right from the start.

Once we completed selecting menu options, the card was fully operational, and Windows was totally configured for the MGA without using the Windows Setup or modifying an .INI file. The latest version of the drivers is very stable and fixes some of the minor complaints with older versions. The Matrox Mode-Switch allows changing both resolution and pixel depth (the number of colors) with hotkey combinations. In the past, this feature would always load Windows in the highest resolution. Now it comes up using the first one in the user-defined list.

The MGA line supports Matrox's custom QCDP (Quality Color Dithering Process) drivers that simulate 24-bit true color in 8-bit modes. The screen redraws slow down a bit, but the image quality is hard to tell from real true-color operation. These drivers, along with Matrox's Dyna-View drivers, diagnostic utilities, color calibration software, and on-the-fly JPEG compression for Windows, are included with all the boards. A two-year warranty and unlimited toll-free technical support round out the packages. That kind of support is a real advantage, since Matrox is located in Canada.

STRONG PERFORMER

When it comes to performance, the MGA/PCI combination proves outstanding. The Graphics WinMark score in 1,024-by-768 (with 256 colors) mode was 26, and at 800-by-600 (with 24 colors) it scored 11. To get an idea of just how good that really is, the VL-Bus version of the first MGA card, tested on a 66-MHz 486DX2 system, had WinMark scores of 14.1 and 7.4. The test system with the MGA card installed scored 54.4 on our Winstone benchmark test at 1,024-by-768 resolution; it scored 48.4 at 800-by-600.

The first MGA cards won their Editors' Choice for features and performance. With its improved design, high performance, lower cost, and PCI speed, the MGA II may well become a graphics standard for power users. □

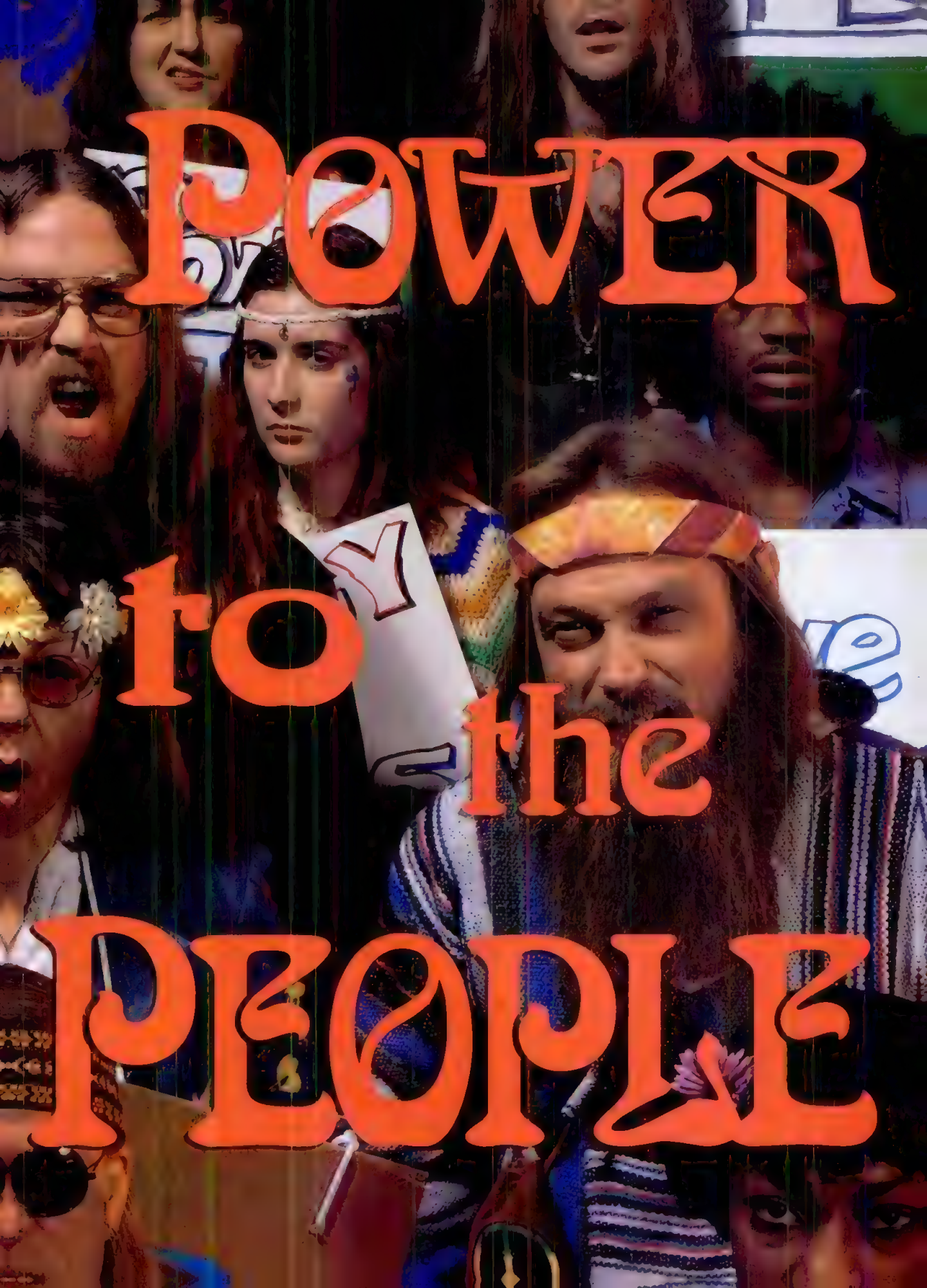
FACT FILE

Matrox MGA Ultima II PCI

Matrox Electronic Systems Ltd., 1055 Saint Regis Blvd., Dorval, Quebec, Canada H9P 2T4; 800-361-1408, 514-685-2630; fax, 514-685-2853

List price: from $499 to $1,699.
As tested: $599 with 2MB VRAM
In short: Matrox's new 64-bit graphics cards are stunning performers with newly reduced prices that make them hard to resist.

426 ON READER SERVICE CARD


POWER
to the
PEOPLE

Now more than ever, we're giving power to the people. Our Pentium-based PCI systems are priced hundreds, sometimes thousands of dollars less than competitors' comparably configured Pentium systems. That's PC power everyone can afford!

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Best Overall Systems Supplier

1993

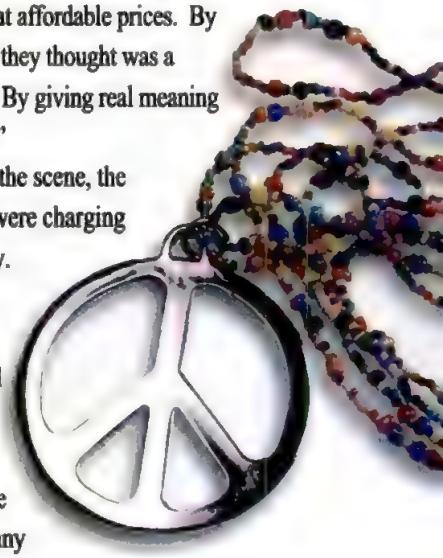
Best Service
Best Mail Order Co.

Best Service

You Got It, Baby!

By the Time We Get to Woodstock

When historians write the history of the personal computer industry years from now, they'll remember Gateway 2000™ as the radical PC manufacturer that gave power to the people by selling the highest-quality, latest-technology computers at affordable prices. By showing PC buyers a level of service they thought was a throwback to the peace and love era. By giving real meaning to the tattered, worn-out term "value."



When Gateway 2000 came onto the scene, the establishment computer companies were charging whatever they wanted for technology. Gateway was a real downer to them because we began selling the same technology for a whole lot less. And the buyers were very smart. They shouted, "Hell no, we won't go," to the big companies, and took a chance on the revolutionary Midwest company called Gateway 2000. Soon a great legion of people — even more than Woodstock attracted — was buying Gateway PCs.

Today, Gateway 2000 is bigger than many of the companies for which it was an alternative. So why should you buy a Gateway computer today? Same reasons as in the beginning. You still get the best price, quality and service from us.

Demonstrations

That's why, for the third consecutive year, we swept *Computer Shopper's* Best Buy Awards, winning every product award we were eligible for and being chosen as the Best Overall Systems Supplier. (Thanks, *Shopper* readers!) That's why we took five top honors in *PC World's* World Class Awards, including Best Mail Order Company and Best Service and Support. (Thanks, *PC World* readers!) And even though we're now a Fortune 500 company, we still champion anti-establishment thinking. Check it out. You'll find GW2K is far-out, groovy and totally unreal!

We dedicate this ad to the memory of Sol Pessin, one of our special customers who believed in us during the early days. We'll miss you, Sol.

GATEWAY2000

"You've got a friend in the business"®

800-846-2063

Gateway Gives You Performance

The Eagle has Landed

When Gateway introduced a Pentium™-based system — loaded — for under $4,000, everybody in the industry knew the Eagle had landed. The best PC value on the planet had arrived! The editors of *PC/Computing* heralded the accomplishment by naming it Best Desktop of 1993.

Then we topped our achievement by offering *four* Pentium processor-based systems, including a *new 66MHz model*, priced from $2,495 to $3,995. Now that's a giant leap in value for one of the highest-performance PCs on earth. These systems are tomorrow's technology available today at affordable prices — only from Gateway.

Our P5 systems include Intel's 64-bit Pentium processor, which moves instructions and data twice as fast as a 486 system. The P5 PCs get another performance boost from a PCI local bus. The PCI bus can operate 10 to 15% faster than a VESA® local bus. The PCI bus' "plug and play" feature makes your PC easier to use, too, by automatically configuring peripherals.

Space-Age Video

The PCI bus is coupled with a space-age video system, with 2MB standard video memory giving you 64,000 colors at 1024 x 768 resolutions. The PCI-based video system uses a high-performance 64-bit interface to video memory that achieves 16 million colors, true 24-bit, in VGA and SVGA resolutions. Our standard video system gives you the best overall performance on the market.

The net effect of the PCI local bus and this video system is performance that will send you into orbit. It's definitely far-out!

486 PCI Local Bus System is A-OK

The PCI local bus and PCI video system are also available in a 66MHz 486DX2 system, Intel® verified to be Pentium upgradable. Another A-OK value in a high-performance system from Gateway!

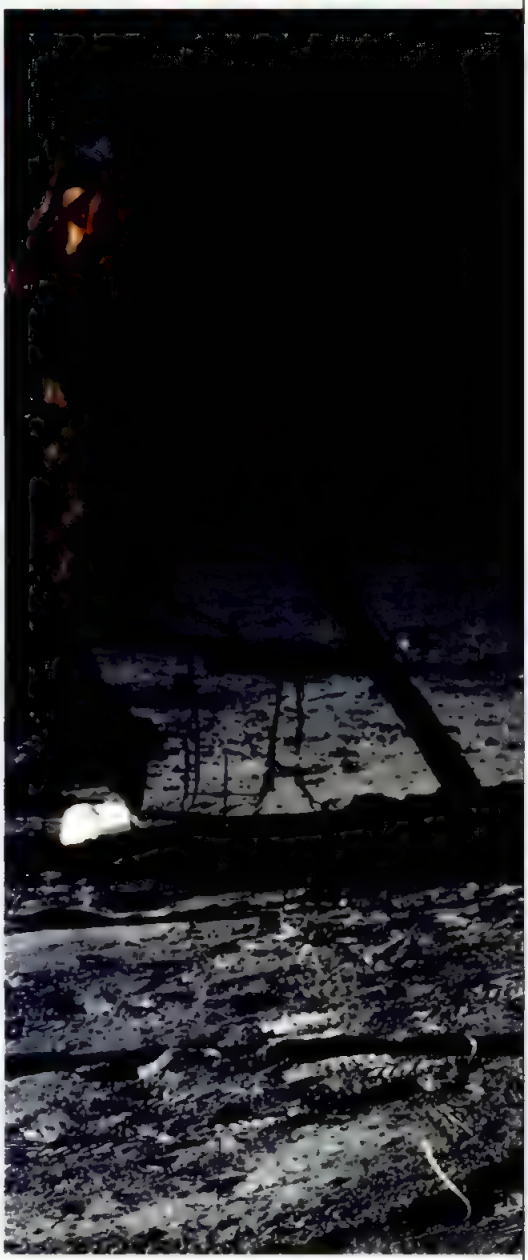


Photo courtesy of NASA. Thanks!

GATEWAY2000

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8 0 0 - 8 4 6 - 2 0 6 3

That's Out Of This World!

Our P5-60 was named Best Desktop of 1993 by the editors of PC/Computing. *"(It) is nearly twice as fast as its nearest competitor at Windows operations. When it comes to top-of-the-line desktop systems, you can't beat high performance for a low price," states the editorial.*

New this month is our 66MHz Pentium-based system for only $3,995.

Best Desktop of 1993

intel inside

Be A Trend-Setter With A

Our 4DX2-66V model has to be one of the most highly decorated PCs in the history of the industry. For good reason! Like other Gateway VESA and integrated systems, it's a very attractive value.

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4DX2-66V
Best Desktop

4DX2-66V
Best Windows PC

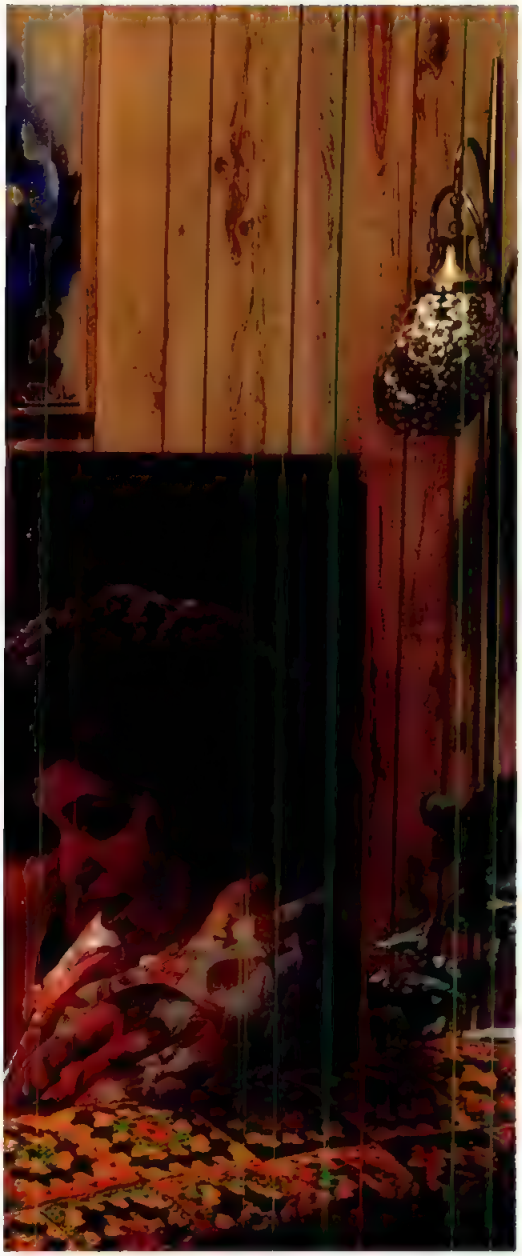
4DX2-66V

4DX2-66V

4DX2-66V

4DX2-66V

Gateway VESA Or Integrated PC



Our Family PC comes with CD-ROM, sound card, speakers, joystick, fax/modem and multimedia software. You choose one software option from five great Family PC multi-title packages. Some of the outstanding titles you can get are: Microsoft Works,™ Dinosaurs and Encarta,™ Cinemania,™ Time Almanac, Links Golf Collection, The Animals, MicroProse™ Game Pack, MECC Elementary Education Pack — and more!

You'll be a trend-setter in your office or neighborhood if you choose a Gateway VESA® or integrated system because there's nothing more fashionable than a great buy. Everybody wants one!

VESA a Go-Go

Our VESA local bus machines give you go-go performance at a fab price. VESA, which stands for Video Electronics Standards Association, assures you of compatibility with any VESA peripheral. These systems are also upgradable to a Pentium™ OverDrive™ Processor if you need more processor power in the future.

Integrated PCs Sock it to 'Em

Our integrated systems definitely sock it to the competition. Offered in space-saving mini desktop cases, our local-bus integrated PCs give you twice the video performance available in many standard desktop machines. In fact, video performance in our integrated systems is similar to, or better than, that found in many of our competitors' high-end systems.

Of course these machines are also upgradable to a Pentium OverDrive Processor.

Our special Family PC, with full multimedia capabilities and some exciting software choices, is priced at only $1,995. Ask us for details.

If you want a mod PC for the fewest dollars possible, you want an integrated system from Gateway. You can bet your bippy on that!

Energy Stardom

All Gateway 2000™ VESA local bus and integrated systems wear the Energy Star seal to show they comply with energy-saving guidelines established by the EPA. Our commitment to the Energy Star program is just one of the ways we're working to help the environment — and to help you save money!

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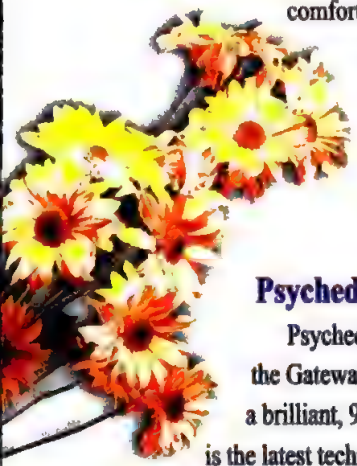
For The Rolling Stone In You.

Whether you travel constantly from continent to continent or occasionally from office to home, Gateway has the perfect portable PC to keep you rollin' on down the highway.

Easy Rider

The revolutionary HandBook® 486 gives you more MIPS per pound than any other PC! Plus, the HandBook is the answer to the most common question seasoned portable users ask themselves: should I take my portable or not? Is it worth the hassel? With a HandBook, you'll never ask yourself that question again. It's so small and light, it's effortless to carry. The decision is automatic: of course you'll take your HandBook. You'll never want to be without it! The HandBook is a truly extraordinary product that will forever change the way you use a PC.

The HandBook has all the features that matter to you, too, including: ideal weight and size (less than 3 pounds, about the size of a day-planner); plenty of power (genuine Intel SL Enhanced 486 processor); great screen (bright, 7.9-inch backlit VGA display); comfortable 78-key keyboard; EZ Point integrated pointer (no need to carry a clumsy mouse); excellent battery life (up to four hours); suspend/resume (a handy feature that allows you to stop work any time and resume later without losing data or restarting the system).



Psychedelic Day-Tripper

Psychedelic color for flower children of all ages. That's the Gateway 2000™ ColorBook™. The ColorBook includes: a brilliant, 9.4-inch VGA color screen (dual-scan STN color is the latest technology in color displays); 486 performance (genuine Intel SL Enhanced 486 processor); excellent portability (weighs less than 5.7 pounds and is ultra-thin — just 1.77 inches); simultaneous video up to 1024 x 768 resolution; a built-in trackball (very easy to use); two PCMCIA Type II slots (can also be used for one Type III PCMCIA card); great battery life (up to four hours); suspend/resume feature.

If you want dazzling color at a mono price, look no further than the ColorBook.

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Gateway Has Groovy Portables.

On your next trip, be sure to take along a good book
That's a HandBook or a ColorBook from Gateway 2000!

HandBook
Best Subnotebook

HandBook
Best Subnotebook

HandBook
Best Hand-Held Palmtop

intel inside

Add A Twist

Shown here is our 4DX2-66V model loaded with options including a 17-inch CrystalScan monitor, combo floppy drive, multimedia kit with optional Yamaha speakers, Colorado Memory Systems tape backup unit, FlightStick and Epson Stylus 800 printer. With multimedia, the sights and sounds of any era are available to you with a click of your mouse. Right on!

intel inside

Thank You

Thank you, Gateway customers everywhere, for your support in 1993. As you can see by the number of major industry awards we received, it was another banner year for Gateway 2000. And we owe this success to you. Our most treasured honors are the "Readers' Choice" awards that come from PC users. The majority of our awards are this variety, which is why we feel so fortunate this year.

Thanks again for these groovy tributes. We'll do everything in our power to live up to the confidence you've shown in us. You're the best!

Your Friends at GATEWAY2000

January 1994
Desktops — #1 in Overall Reliability & Likelihood of Buying Again
Portables — #1 in Overall Reliability, Repair Service & in Likelihood of Buying Again

Best Service and Support
Best Mail Order Company

Best Desktop of 1993

Best Overall Systems Vendor
Best 486 Desktop
Best 486 Notebook
Best Subnotebook

Company That Provides the Best Service

Programming Languages

Microsoft's Visual C++ 1.5 Adds ODBC and OLE 2.0

BY RICHARD HALE SHAW

Things move fast in the world of Windows applications development. Microsoft has released its third C++ environment in less than a year. The $599 Microsoft Visual C++, available only on CD-ROM, includes C++ support for Object Linking and Embedding (OLE) 2.0 and Open Database Connectivity (ODBC), plus all the requisite software developers kits (SDKs), tools, and tutorials. While you can use it only to write 16-bit Windows apps, Visual C++ 1.5 can also run on Windows 3.1 and Windows NT.

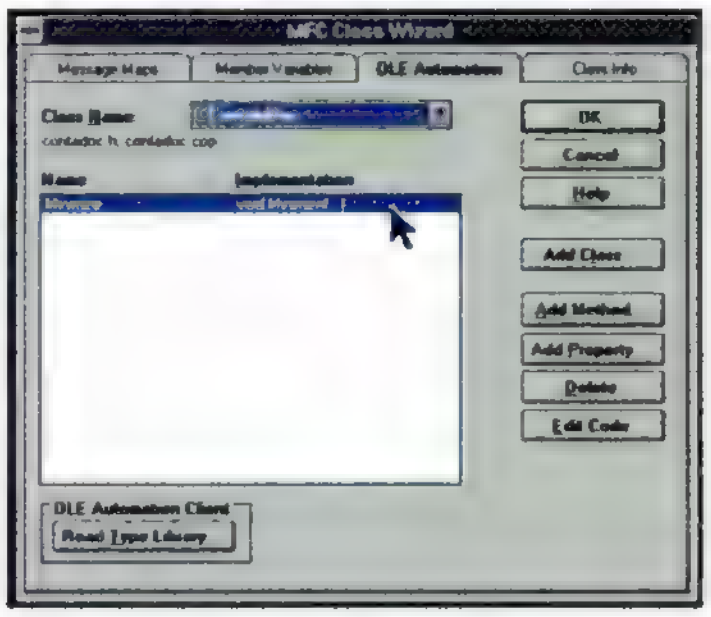
VC++'s support for OLE 2.0 and ODBC is comprehensive and complete; it includes everything you'll need to create Windows applications that take advantage of these technologies. The package includes the Microsoft Foundation Class (MFC) library, Version 2.5, with C++ class encapsulation of OLE 2.0 and ODBC, along with the OLE 2.0 and ODBC SDKs, testing and debugging tools, DLLs, and on-line tutorials. It even includes ODBC drivers for Access, Btrieve, dBASE, Excel, FoxPro, Oracle, Paradox, SQL, and text files in the package.

HELP FROM WIZARDS

The VC++ integrated development environment has changed little in Version 1.5, and it lacks sophisticated editing and project management facilities like those found in the $499 Borland C++ 4.0 (see the First Looks evaluation in this issue). But VC++'s key components—AppWizard, ClassWizard and AppStudio—have been modified to accommodate the new features of MFC.

To build a simple database application, you select an ODBC data source and table from a new dialog in AppWizard. It will generate an application dialog for displaying and editing the columns of the table, as well as MFC-derived C++ classes to manage the table and data members tied to the table's columns. You have only to use point-click in AppStudio and ClassWizard to tie these data members to edit fields in the dialog and the application is ready to compile and run.

In database applications, MFC provides all the functionality required to select, open, and read records from ODBC database files, as well as to navigate, display, and update a database via the VCR-like buttons on the built-in toolbar. In OLE 2.0 applications, MFC provides support for visual editing (in-place activation), drag-and-drop, and the ability to cut and paste OLE objects via the Clipboard. And you can combine both capabilities to create OLE-aware database applications.



FLIP: *Tabbed dialogs make things easier.*

Perhaps the only real disappointment with this product is the lack of general improvements to the integrated development environment and the lack of accompanying OLE and ODBC support in the 32-bit edition. The latter are expected to follow when 32-bit OLE 2.0 ships this spring. In the meantime, you won't find a simpler means of creating OLE 2.0 and ODBC applications than Microsoft Visual C++ 1.5.

• List price: *Microsoft Visual C++, Version 1.5, $599; upgrade, $99.* Requires: *8MB RAM, 40MB hard disk space, Microsoft Windows 3.1, CD-ROM drive.* Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080.

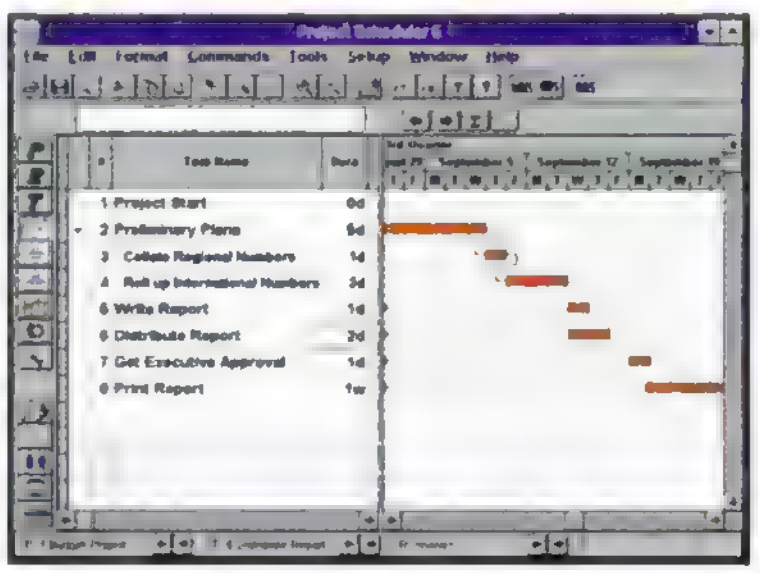
Circle 424 on reader service card

Project Management

PS6: High-End Features, Midrange Price

BY DON WILLMOTT

It's hard to convince a nonprofessional project manager that any project management package can ever be easy to use. You can see the potential, but it's is always hidden behind confusing terminology, databases, and graphs. Scitor Corp.'s first Windows-based version of its flagship project management package, the $695 Project Scheduler 6 for Windows. is powerful, professional, and good-looking, but PS6 will still be daunting for anyone who might want to just dabble in project management.



GUI: *PS6 looks good in Windows.*

Fortunately, the colorful main screen includes just about all the tools you'll need. As in most Windows apps, everything you see is customizable, and printing—long a project management problem—is a joy compared with what you'll find in any DOS-based package.

PS6 has some unique cutting-edge project management features that make it stand out from its competitors, including other packages that cost thousands of dollars more. Its support for Open Database Connectivity (ODBC), for example, means that you can create live links between your projects and other databases in your organization that might deal with resources or staff.

PS6 also has what it calls an Advanced Resource Tracking Spreadsheet, which lets you analyze data on who, what, when, and resource availability. Scitor does indeed succeed in making this tool look and behave like a spreadsheet, though, as in most parts of the program, arcane project management jargon is much in evidence.

Professional project managers will like the fact that PS6 can support three-layer Work, Resource, or Organizational Breakdown Structures, and the program excels in multiproject management and maintaining several small projects as subsets of a master project.

• List price: *Project Scheduler 6 for Windows, $695.* Requires: *4MB RAM, 4MB hard disk space, Microsoft Windows 3.1.* Scitor Corp., 393 Vintage Park Dr., #140, Foster City, CA 94404; 415-570-7700.

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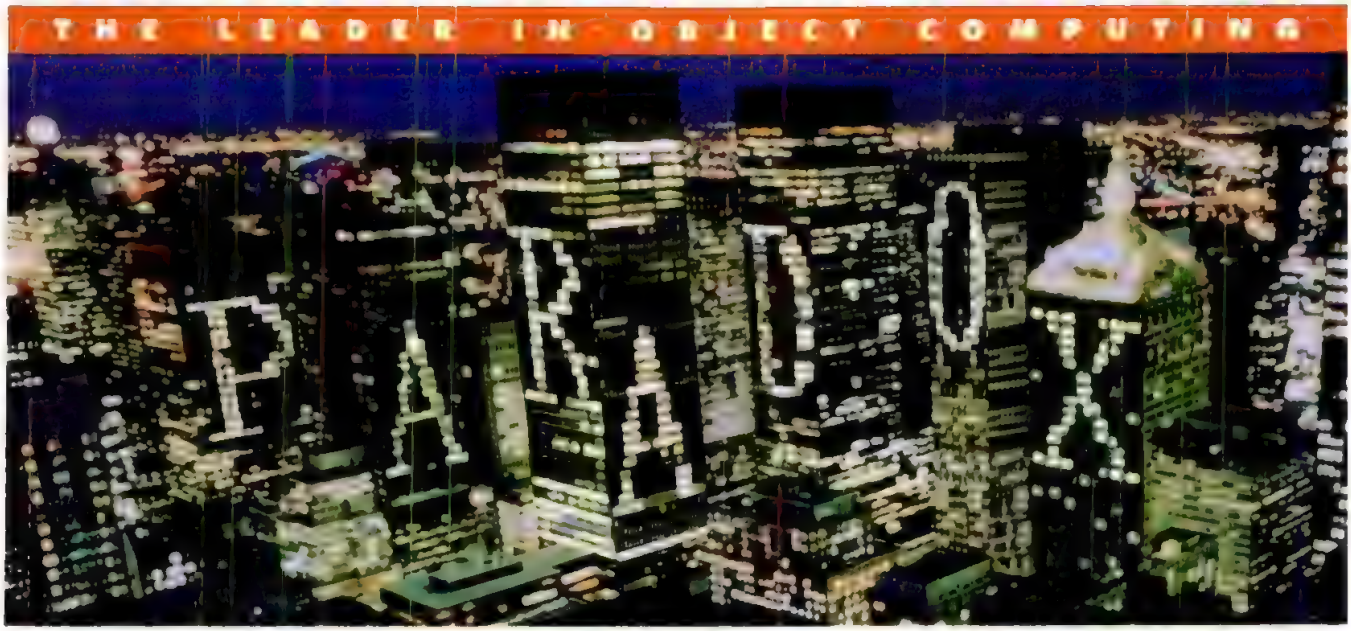

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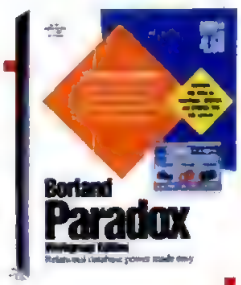

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Sound

Windows Sound System 2.0 Targets Business Users

BY JOHN R. QUAIN

When Microsoft speaks, everybody listens. At least that's what the company hopes will happen with its Windows Sound System, Version 2.0. Boasting a new audio compression scheme for voice and some revamped Windows applications for adding sound to OLE documents, Sound System 2.0 is available in two different packages.

In the full $219 hardware and software package, Sound System 2.0 includes the same 16-bit sound board that shipped with the previous release and a redesigned microphone. The new microphone sits at the end of a bent spindle and can be attached to a monitor or placed in a stand to sit on a desktop.

The board itself remains unchanged from the previous version. It supports 16-bit, 44.1-kHz stereo playback and recording for maximum audio fidelity. The board installs easily and will even switch interrupt settings automatically if you later install a board with a conflicting IRQ.

SPEAK UP: *The directional microphone is a new addition to the bundle.*

SHORTCOMINGS

Unfortunately, the sound board has several shortcomings. Although it delivers acceptable audio quality, it has been eclipsed by competing products that offer cleaner sound for the same price. The board lacks an internal analog audio connector, making it all but impossible to use with an internal CD-ROM drive. It doesn't support external MIDI devices and is only able to play back MIDI files by using a four-operator FM synthesis chip. It falls far short of the MIDI sound quality offered by boards that use a wavetable lookup approach.

Of course, Sound System 2.0 isn't intended for weekend composers or professional musicians. It's aimed squarely at business users, with software features specifically designed to meet their needs. The most significant changes are in the software bundle, which is now available without the sound board for $79.

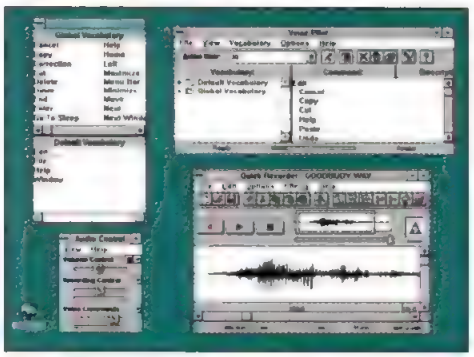
There are several improvements, foremost of which is Microsoft's TrueSpeech codec (compression and decompression algorithm). Originally developed by DSP Group, TrueSpeech compresses voice recordings while maintaining maximum fidelity. Its faithfulness in making spoken-word recordings is quite good.

We compared mono voice recordings made with an 8-bit, 11-kHz setting to a 1-bit TrueSpeech recording and found that TrueSpeech annotation was nearly as pleasing to the ear and saved considerable storage space. A 10-second voice recording, for example, takes 117K in 8-bit 11-kHz mode, while the same file only takes 13K when TrueSpeech is used.

QUICK RECORDER

Additional improvements have been made to the Quick Recorder software. It now has two views: a small view without the waveform display and an expanded view so that you can edit .WAV sound files. You can fade in or out, speed up the recording without increasing the pitch, add echo, or trim silences. There are preset sampling rates and sizes, and the recording source can be either a microphone or line input (such as a CD playing on a CD-ROM drive).

Once you've made a recording, you can drag and drop the voice annotation or music clip into any OLE-compliant application and choose an icon to mark the spot. Making recordings proved to be a simple matter, although in its expanded view, Quick Recorder was noticeably slow, especially when compression was required.



SOUND TOOLS: *The Windows Sound System includes several voice utilities.*

The other major software revisions are in the Voice Pilot voice recognition utility, which lets you utter simple voice commands to navigate through Windows. In conjunction with Dragon Systems, Microsoft has improved the ease with which you can add words to the vocabularies, create new vocabularies for specific applications, and train the software to recognize your own particular vocal intonations. It can handle 256 different words at a time and an unlimited total number of words.

In practice, the Voice Pilot may still be regarded as more of a toy than a natural interface with a PC. The Voice Pilot employs a discrete speech-recognition engine that relies on phonemes. Less computing power is required, but some accuracy is sacrificed.

The balance of the software includes a Proofreader utility that uses a synthesized female voice to read back the contents of spreadsheets (which you can check against an original hard copy), the Music Box audio CD player, the Sound Finder utility for associating sounds with Windows actions, and the Audio Control for adjusting the playback and recording volumes.

The software is still the best available for business users who want hassle-free audio features added to their PCs. The software/microphone package is particularly attractive, but in order for it to be compatible with the Windows Sound System 2.0 software, sound board makers need drivers for the software. So check with individual manufacturers.

• List price: *Microsoft Windows Sound System, Version 2.0, with 16-bit audio card, microphone, headphones, and software, $219; with microphone and software only, $79.* Requires: *2MB RAM, 9MB hard disk space, Microsoft Windows 3.1. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080.*

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PC MAGAZINE EDITORS' CHOICE
September 14, 1993
Nanao FlexScan F550i-W

Nanao, the technical leader in monitors has done it again. In addition to being the top choice of today's CAD/CAM, DTP and Windows users, Nanao's award-winning FlexScan monitors now have a remarkable energy-saving system – PowerManager.

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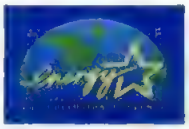

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Optical Character Recognition

TypeReader: A Sophisticated Approach to OCR

BY JAMES KARNEY

ExperVision Corp.'s $895 TypeReader Professional is bringing a whole new level of sophistication to optical character recognition (OCR) software. The program not only converts scanned pages into editable text, it can retain the entire layout of a document—including tables and line art.

TypeReader was originally designed to read alphabets like Japanese Kanji, which has more than 7,000 symbols. To do this, the designers developed a technique known as Machine Learned Fragment Analysis. In this process, a computer reads thousands of type samples with different fonts and image qualities to pinpoint the stable elements of each character and use them for identification. The resulting engine is used to perform TypeReader's primary OCR. A series of filters is then used both to overcome traditional recognition obstacles, such as fragmented or touching letters and kerning, and to help adapt to unusual fonts.

2,000 FONTS

The recognition accuracy in TypeReader's OCR engine has been enhanced. The engine now has the ability to recognize more than 2,000 fonts. The Autoskew control can compensate for pages scanned as much as 12 degrees off center (this compares with 2 degrees in the original edition). The result is improved handling of both degraded pages, such as faxes and photocopies, and pages fed through a sheet-feeder.

Using TypeReader is very straightforward. The program's interface places scanner controls and import functions on a set of button bars called the Gallery, located just under the menus. The major portion of the window displays the document being worked on. A set of button bars lets you change the font type and text attributes of recognized characters, as well as define the type of processing you want done.

Clicking on the Auto button runs you through three recognition phases. First, the page is loaded into memory. A bitmapped image is displayed with a bar depicting progress. Next, the bar moves over the page, locating the blocks of text and drawing arrows in the order they will be processed. Finally, the bar moves down the page during the actual recognition process. A dictionary checks spelling.

You can redefine the location and order of processing, or repeat any portion of the operation that wasn't satisfactory. Once the image is converted, the document is shown on-screen with formatting. You use the Tab key to move to any letters the program questions or that aren't identified, and a pop-up shows the original image.

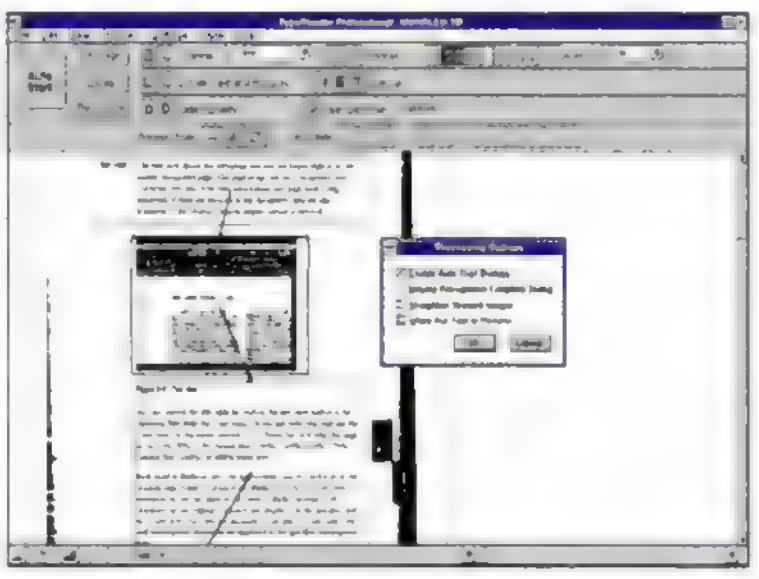
Once editing is done, you can save the file in almost any major word processing or graphics format.

GREAT RESULTS

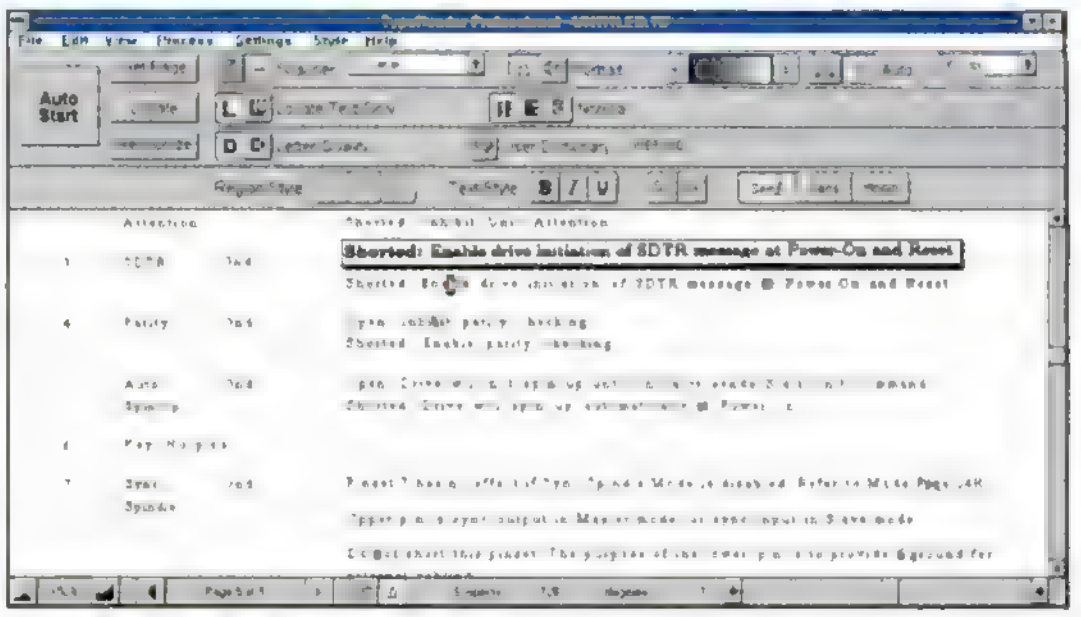
TypeReader did an outstanding job with a five-page test document designed to choke it. We used a faxed letter, a photocopy, a parts list from a technical manual, a somewhat exotic newsletter, and an onionskin invoice. The last two items were printed on colored paper and were each in a slightly crumpled condition when placed on the scanner.

After recognition, the faxed letter did contain several errors, but TypeReader did a much better job than other OCR packages we tried. The invoice came through the process with no real difficulty, and the photocopy was handled without an error.

Most impressive was the parts list. This page contained a complex table that was printed on creased green paper. We had to adjust the brightness and contrast of the scanner a bit, but TypeReader correctly identified the table's layout and produced a very clean page. We then modified the layout with TypeReader's formatting options and exported it in .RTF format. Microsoft Word for Windows loaded it exactly as it looked in the OCR package. Next, we used TypeReader's Numeric Zone feature to identify a section of the parts list, reprocessed the page, and exported it as an .XLS spreadsheet without problems.



CONTROL: *TypeReader's features can be accessed from its main windows. It works well on multicolumn documents.*



SETTING TABLES: *TypeReader does a particularly good job of handling recognition of complex table formats.*

HANDLING COMPLEX LAYOUTS

TypeReader handles complex layouts containing exotic fonts very well. We chose the program's default settings and read the newsletter page, which alternated between one and two columns and included a mix of display fonts (such as American Unical) in varied sizes. We saved the unproofed file in .RTF format and printed it using Word 6.0. All the formatting was preserved, and TypeReader saved the two line-art images on the page in separate files.

While no OCR product is foolproof, TypeReader tops its peers by offering users much-improved accuracy and a better user interface. The ability to capture formatting and layouts, properly handle tables, and retain embedded graphics extends the usefulness of this type of product.

• List price: *TypeReader Professional, $895.* Requires: *4MB RAM (8MB recommended), 12MB hard disk space, Microsoft Windows 3.1. ExperVision Corp., 3590 N. 1st St., San Jose, CA 95134; 800-732-3897, 408-428-9988; fax,* 408-456-0823.

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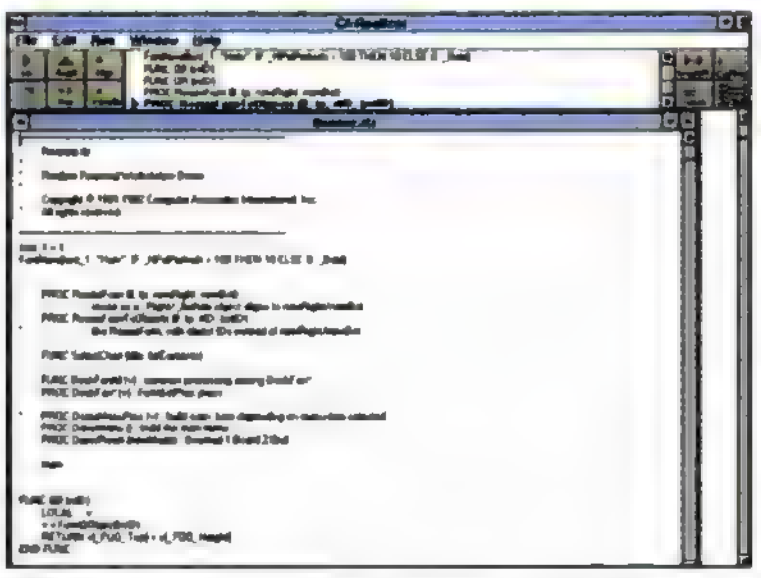
Programming Languages

CA-Realizer 2.0: BASICally Easier Than C Alternatives

BY STEPHEN W. PLAIN

CA-Realizer 2.0 ($99 through March 31, $247 thereafter), the long awaited upgrade to Computer Associates' BASIC development system, provides cross-platform compatibility between Microsoft Windows and OS/2 and has several enhanced development features. Many traditional programmers are searching for Windows application development tools that work faster than C, but they are uncomfortable with event-driven programming environments—Microsoft Visual Basic, for instance. These developers will find refuge in CA-Realizer and its familiar procedural model.

CA-Realizer comes complete with both a Windows and an OS/2 version for development on either platform. Both versions have identical interfaces, allow you to create royalty-free runtime executables of your programs, and share the same source file formats. This seamless cross-platform compatibility is perhaps the most valuable aspect of CA-Realizer, and it is not found in competing products such as Microsoft's Visual Basic.



DEBUG: *CA-Realizer provides a full-function debugger that lets you define breakpoints and watch variables.*

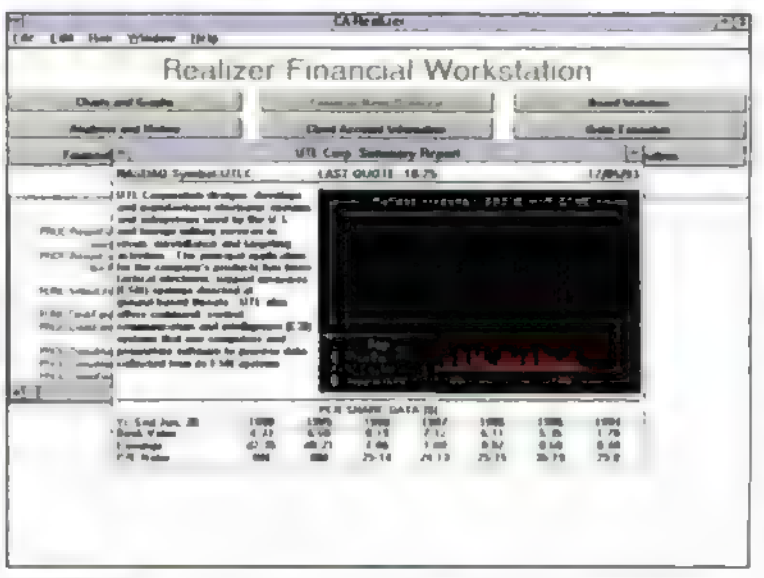


CHART IT: *CA-Realizer's built-in Programmable Application Tools let you create sophisticated charting programs.*

BASICALLY DIFFERENT

Instead of linking source code to individual objects in a GUI environment, CA-Realizer uses more traditional source modules that contain your procedures, functions, and main program logic. In CA-BASIC, CA-Realizer's programming language, you interact with the operating environment with SELECT CASE control structures.

CA-Realizer's application interface consists of graphical forms, each made up of interface objects with unique identifiers. These identifiers become the objects of each CASE statement in the source code and are handled individually. While this approach requires considerably more code than a Visual Basic application, the advantage is that you can see the entire logic of a form in one place.

CA-Realizer also provides FormDev, a tool that allows you to paint forms and add buttons, check boxes, list boxes, spreadsheets, and bitmapped images from a floating tool palette. FormDev lets you work with forms that are organized by project, and it automatically generates the source code for them when you save the project. FormDev will create a source code module for each form as well as a main source code module for the project, all of which can be modified.

FormDev can also open either saved form specifications from previous FormDev sessions or import a form's source code to be modified visually. If you make any changes to the source for a form, you must import the source into FormDev to work on it again—not just the saved form. Otherwise, your changes are lost.

In FormDev, CA-Realizer flirts a bit with the event-driven model, giving you the ability to enter "action code" to respond to events like Left Click and Get Focus.

Although some support for databases has been added to this version of CA-Realizer, the support is limited for such a tool. Xbase files can now be imported and exported into memory variables, but there are no built-in functions to index or query an existing .DBF file. In FormDev, you can define what is termed a "database form" from an existing .DBF file that creates text boxes for each field. These text boxes, however, do not remain linked to the data.

CA-Realizer includes eight Programmable Application Tools that can be used when building applications, including animations, charts, graphics tablets, menus, spreadsheets, text logs, and the Scheduler. These tools can be created from code to use their own separate windows, and some can be placed within forms. Several new types of charts have been added for this version, including pie and Gantt charts, and formatting control has been improved, as well. The spreadsheet tool offers considerably more flexibility now, with features that allow area selections, added control over fonts, the ability to hide columns and to create read-only spreadsheets.

ORGANIZER

A CA-Realizer component called the Project Builder lets you define which source, bitmapped images, and other needed files belong to a particular project and create the executable file. The Project Builder can also create installation disks for your application that include an installation program.

CA-RET, the company's standalone database reporting tool, is now bundled with CA-Realizer. CA-RET is a powerful and intuitive report writer that lets you visually define reports based on stored database tables. CA-RET reports can be controlled from CA-BASIC code via DDE conversations.

CA-Realizer will appeal to some programmers because of its use of traditional code modules, and to all other programmers because of its platform-independence. It is not, however, a tool for non-programmers looking for an easy way to create graphical applications.

- List price: *CA-Realizer 2.0, $247 ($99 through March 31, 1994).* Requires: *2MB RAM (4MB RAM for OS/2), 5MB hard disk space, Microsoft Windows 3.x or OS/2 2.1. Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY, 11788; 800-225-5224, 516-342-5224; fax, 516-342-5734.*

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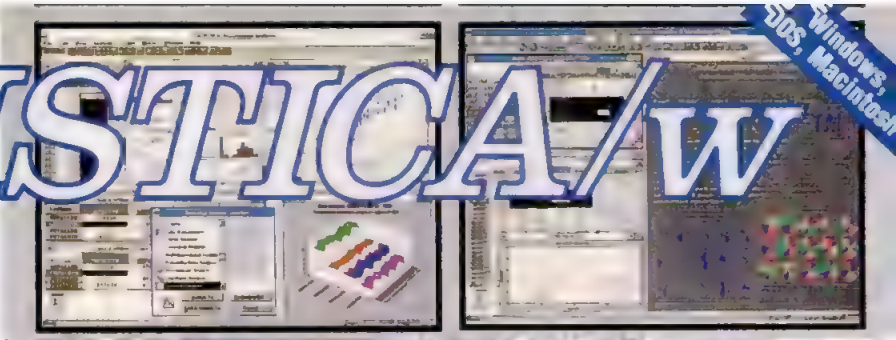
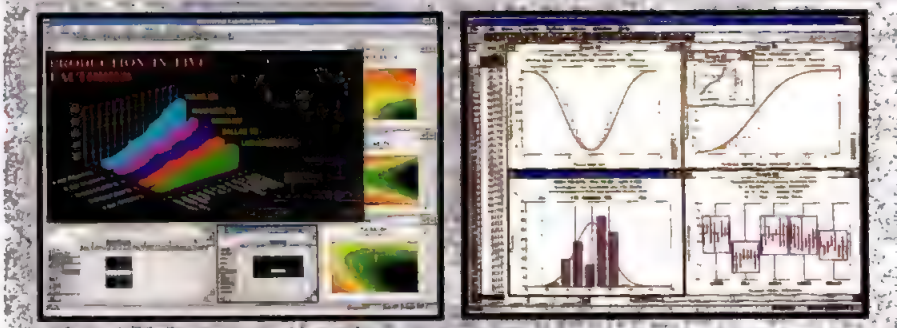
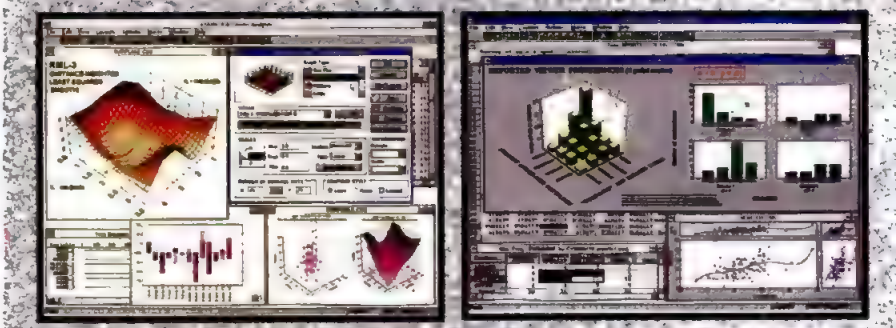
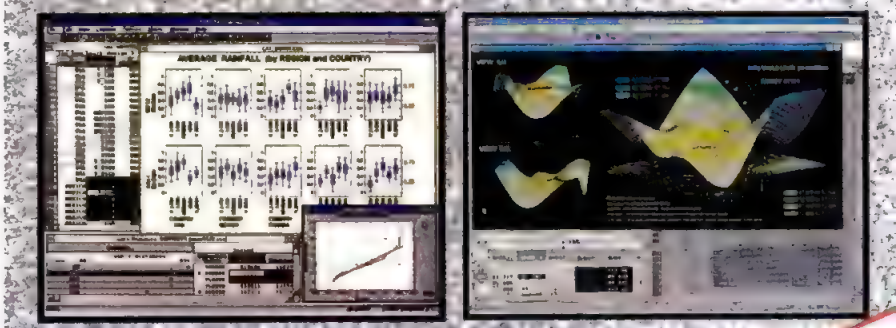
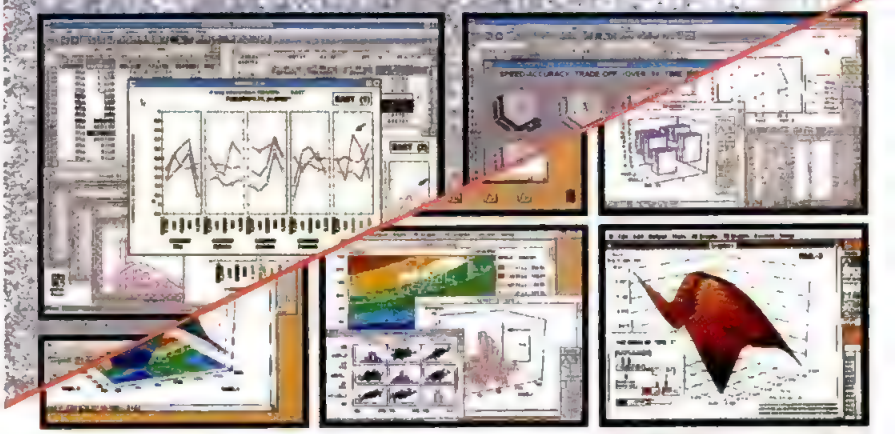
Windows, DOS, Macintosh











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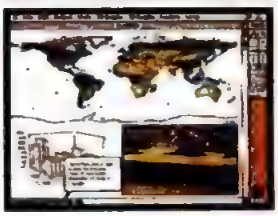

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intel inside

The short list for volume buyers with a long list of expectations.

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March 16, 1993
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CIRCLE 226 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Anush Yegyazarian

IMPROVED

Bring Banking to Your Door

Microsoft Corp. has upgraded Microsoft Money 3.0, its financial management software. This version offers improved investment tracking and management with five new Wizards to aid your financial planning: Loan Calculator, Mortgage Planner, Savings Calculator, Retirement Planner, and Interest Estimator.

The real bonus, however, is in the additional on-line services Microsoft has put in place. One, called Bank On-Line, is done in conjunction with First National Bank of Chicago, Michigan National Bank, and U.S. Bank. For a monthly fee of $7.95, it lets you automatically balance your accounts and conduct transfers between accounts if you have an account with one of the banks. Pay On-Line lets you make your payments electronically, and Quotes On-Line gathers the latest stock prices. The National Payment Clearing House provides the network switching and management.

• List price: *Microsoft Money 3.0, $34.95; after 4/15/94, $69.95; Pay On-Line, $9.95 (20 transactions per month); Quotes On-Line, $3.95 (four calls per month). Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329.*
Circle 402 on reader service card

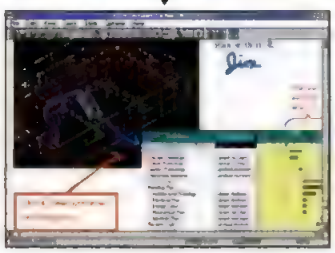
NEW

Your Disk's History On-Disk

Solid Oak Software has released Disk Historian 2.0, a disk-monitoring system that helps you clean up and maintain your hard disk. This Windows-based program monitors DOS and Windows files and can display a number of statistics of any file, such as the number of accesses and the time and date of the last access. You can also query and view information on specific types of files, then delete, compress, or migrate chosen files. It stores information in a dBASE III file format so that data can be imported into spreadsheets or other database programs.

• List price: *Disk Historian 2.0, $59 until June 30; $129.95 thereafter. Solid Oak Software Inc., P.O. Box 6826, Santa Barbara, CA 93160; 800-388-2761, 805-967-9853; fax, 805-967-1614.*
Circle 413 on reader service card

HOT PROSPECT



Conferencing via Modem: Sharing Information in Real Time

Electronic conferencing, especially video conferencing, is becoming a hot area. The problem is, many organizations can't afford the costs of true video conferencing. Those who want the benefits of conferencing but can do without the video should take a close look at **DataBeam Corp.**'s FarSite for Windows.

This inexpensive software combined with a modem (we recommend a 9,600-bps unit) can link you to any colleague and let you share information across your PCs more interactively than you can through a LAN. You can both make real-time annotations to data on-screen and work through the details of projects, or make presentations. A slide-tray feature lets you store and order the information you plan to share, or you can pull screens ad hoc. Either user can scroll, pan, or zoom the shared images. FarSite also includes a common whiteboard, concurrent on-line pointers, and drawing tools.

This release allows only two users at a time, but a forthcoming corporate release will accept up to 64,000 users and will have network and OLE support. At present, there is no way to lock out any of the conference members from making changes to the shared images. The program also lacks private memo space, subchannel communications, and text-search capabilities.

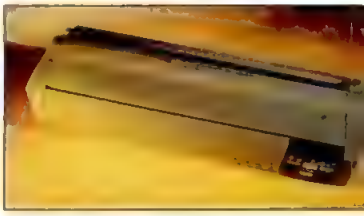
• List price: *FarSite for Windows, $179 per user. DataBeam Corp., 3191 Nicholasville Rd., Lexington, KY 40503; 606-245-3550; fax, 606-245-3528.*
Circle 401 on reader service card

NEW

A Pair of Printing Citizens

Citizen America Corp. has two new printers on the market, one a color portable printer, the other a compact and inexpensive thermal ink jet model.

The Citizen Notebook Printer II has a 360-dpi resolution, prints in either color or black and white, has a 2-ppm print speed, and weighs 2.6 pounds. Its optional $69 battery lasts through 30 to 50 pages of printing and can be recharged in 3 hours. It can handle plain paper, transparencies, and envelopes. Many options are available, including a $69 30-sheet automatic feeder and a $49 car adapter.



The Citizen Notebook Printer II.

For thermal ink jet printing, Citizen has the Citizen Projet II. It features a two-piece print head and ink cartridge so that you don't have to replace both pieces when the ink runs out. The printer has 300-dpi resolution, PCL3+ emulation, and an automatic sheet feeder that holds up to 70 sheets of legal- or letter-size paper. It can be used with envelopes and transparencies. A $175 256K memory card is optional.

Both printers are TrueType font–compatible.

• List price: *Citizen Notebook Printer II, $399; Citizen Projet II, $349. Citizen America Corp., 2450 Broadway, #600, Santa Monica, CA 90404; 310-453-0614; fax, 310-453-2814.*
Circle 404 on reader service card

IMPROVED

Windows Timeslips Punches In

Timeslips Corp. has released a Windows version of Timeslips 5, its time and billing program. Timeslips 5 for Windows has a number of features absent from the DOS version, including a Bill Layout Tool that lets you choose fonts and import graphics, and a Timeslips Navigator in icon format to facilitate tasks. The program also has a more flexible aging system and lets you enter a number of transactions in a batch format. A $599 network version is available.

Photography by Thom O'Connor

The optional $799 TAL module (Timeslips accounting link) provides you with customized reports and also links the billing and payment data from Timeslips 5 to other accounting software. DOS and Windows versions can be used simultaneously and can also share the same files.

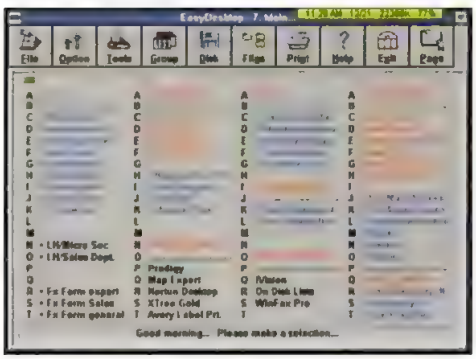
• List price: *Timeslips 5 for Windows, $299 (tracks up to eight people); upgrade from DOS, $99.95. Timeslips Corp., 239 Western Ave., Essex, MA 01929; 800-285-0999, 508-768-6100; fax, 508-768-7660.*

Circle 407 on reader service card

IMPROVED

Managing Windows Without Cuteness

Here's another Windows File Manager replacement, but this one steps away from Windows by avoiding icons and buttons. EasyDesktop 5.0A for Windows, from **MicroSeconds International,** lists your applications along with files or templates in text menus. You can also add a description to each menu item and password-protect it. The program lets you launch applications or macros within applications at scheduled times, and the Help system has been extended and can be accessed on-line. The file manager can find files by name, type, or through a text string, and there's an icon facility so you can search by icon.



EasyDesktop lets those with many files and applications access them more easily.

EasyDesktop allows you to split large files over several floppies and can zip or unzip files from anywhere in Windows. If you don't want to see all your applications all the time, the program also lets you have up to six Virtual Desktops.

• List price: *EasyDesktop 5.0A for Windows, $59.95. MicroSeconds International Inc., P.O. Box 201, Rancho Santa Fe, CA 92067; 800-889-3279, 619-756-0765; fax, 619-756-0855.*

Circle 406 on reader service card

BRIEFS

NOTEBOOKS

The Hurricane, **Aquiline**'s newest notebook, features a sound chip, CPU choices ranging from 486DX/33 to 486DX2/66, 4MB of RAM expandable to 20MB, a 200MB hard disk up to 540MB, active- or passive-matrix displays, a 3.5-inch floppy disk drive, and two Type II PCMCIA slots. It weighs 10 pounds and has a rated battery life of 3 hours. Prices range from $2,253 to $5,440. 518-272-0421.

Micro Express also has a new notebook out. This one has a 486DX2/66 CPU, a 200MB hard disk, 4MB of RAM expandable to 20MB, a 3.5-inch floppy disk drive, one Type III PCMCIA slot, and a 10-inch active-matrix display. It's priced at $4,499 and weighs 7.2 pounds, with a battery life of 2.5 hours. 800-989-9900, 714-852-1400.

Intelligent Notebooks Systems' latest is the ECHOPad. It's available with either a dual-scan passive-matrix or monochrome screen and has CPUs ranging from 486SX/25 to 486DX2/66, 4MB of RAM to 20MB with a PCMCIA card, removable hard disks from 80MB to 340MB, one Type III PCMCIA slot, and an external 3.5-inch floppy disk drive. The systems weigh 4 pounds each with the battery and can last about 4 hours. Prices range from $1,695 to $2,595. 800-588-4674, 408-748-9781.

The Smartbook II, **Commax Technologies**' latest notebook offering, is available with 486DX/33 to 486DX2/66 CPUs; detachable active-matrix, dual-scan passive-matrix or monochrome displays; 4MB of RAM expandable to 32MB; and 120MB hard disks to 340MB. It has built-in digital audio sound and speakers, one Type III PCMCIA slot, and a removable 3.5-inch floppy disk drive that can be replaced by a second battery. The units weigh slightly over 6 pounds each, have a rated battery life of 3 to 4 hours, and range in price from $2,235 to $4,118. 800-526-6629, 408-435-5000.

HARDWARE

Electronics Specialists has a surge

IMPROVED

JetFormed for Your Workflow

JetForm 4.0, the latest version of **JetForm Corp.**'s form software package, has an improved GUI interface, support for VIM 2.0 for wider e-mail compatibility, and new modules for both JetForm Server 4.0 and JetForm Design 4.0.

Distribution Director, added to Server 4.0, helps the forms designer or administrator keep track of and automatically distribute changes to any forms in the company. The Tracking Director lets users or administrators find out where a form is on a route and who has seen it. The Fax Director lets you fax out your forms.

JetForm Design has gained a Forms Dictionary. It lets you store and retrieve forms either as a whole or in part. That way, you can access and change the forms faster. It also lets you make global changes so that a modified clause in one form can be automatically updated in other forms with that clause.

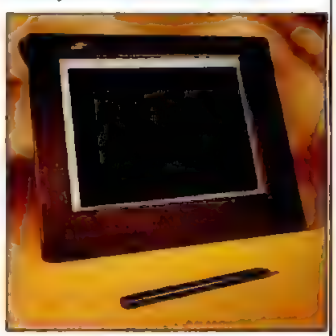
• List price: *JetForm Server 4.0, $1,695 (20 users); JetForm Design 4.0, $495; modules, $495. JetForm Corp., Watermill Center, 800 South St., #305, Waltham, MA 02154; 800-538-3676, 617-647-7700; fax, 617-647-4121.*

Circle 405 on reader service card

NEW

Tablet, Pen System, and Screen

The 3.1-pound VideoTablet VTS-5, **Kurta Corp.**'s newest pen-based LCD tablet, has its own built-in backlit screen. That makes it easier to use in all lighting conditions and allows you to see your work directly on the tablet, eliminating the need to depend on a monitor. The VideoTablet VTS-5 links to any computer or notebook with a 26-pin cable attached through a VTS-5 VGA controller card that goes into the host computer. This EISA or ISA card lets you see the monitor and tablet simultaneously. It supports 640-by-480 resolution in the tablet with 64 gray scales and 1,024-by-768 resolution with 256 colors in the monitor. Kurta bundles Microsoft Pen Extensions for Windows and CIC PenDOS with the tablet; IBM Pen for OS/2 supports the product directly.



Kurta's backlit LCD tablet.

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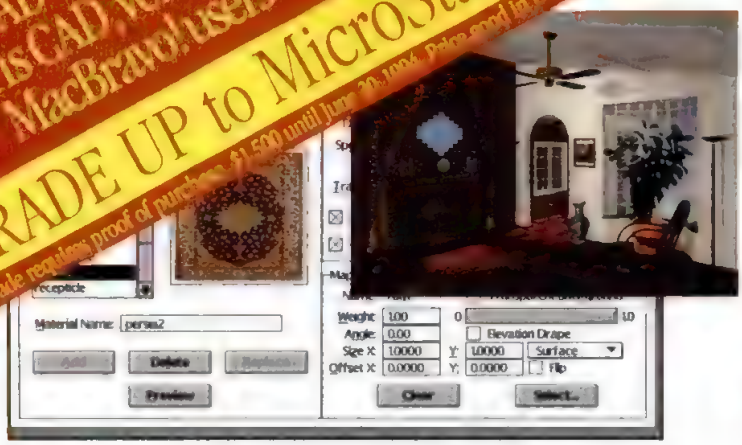

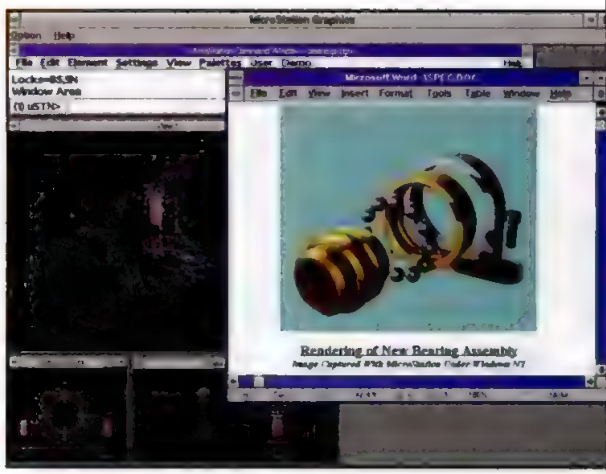

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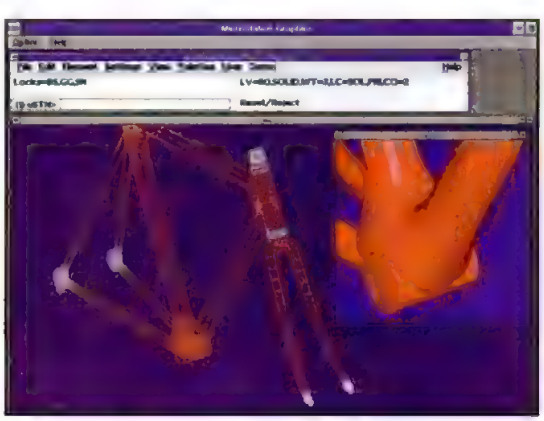

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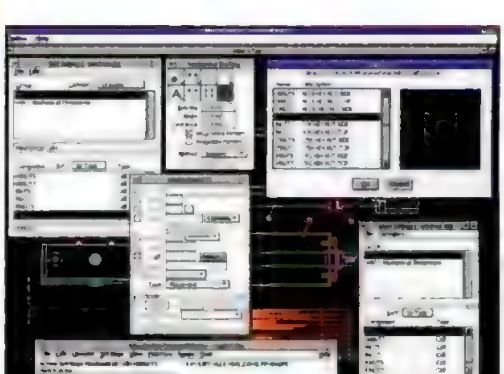

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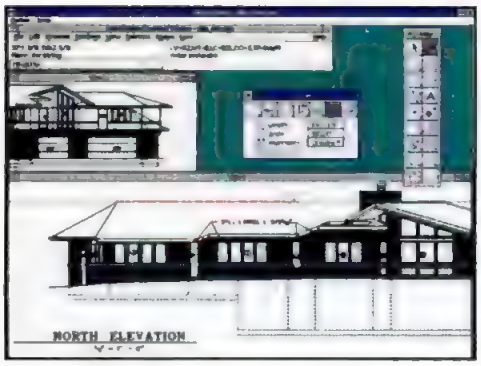

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CIRCLE 048 ON READER SERVICE CARD

• List price: *VideoTablet VTS-5, $1,495. Kurta Corp., 3007 E. Chambers St., Phoenix, AZ 85040; 602-276-5533; fax, 602-276-9007.*
Circle 408 on reader service card

NEW

WP Office Is Getting Connected

WordPerfect Corp. has released a gateway between its WordPerfect Office and Lotus cc:Mail. WordPerfect Office cc:Mail Gateway 4.0 has a migration utility that moves cc:Mail users' mailboxes and folders to an Office account; also, its send options let you set message priorities and security levels, delay delivery, and get receipts. A Message Exchange and Directory Synchronization feature lets managers exchange or modify directories automatically between systems and allows cc:Mail post offices to be added automatically to the Office directory. You can add an unlimited number of attachments, and the software bypasses cc:Mail's 200-recipient limitation by splitting messages.

WordPerfect is also getting into the wireless arena with the help of RAM Mobile Data. Wireless modems let WP Office users access, share, send, and filter e-mail messages and tasks.
• List price: *WordPerfect Office cc:Mail Gateway 4.0, $995; wireless connection through RAM Mobile, $75 (one-month flat rate). WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; 800-861-2507, 801-225-5000; fax, 801-222-5077.*
Circle 409 on reader service card

NEW

Versa Gets an E for Extras

The new Versa E series notebooks, from **NEC Technologies**, have more powerful CPUs; faster local-bus video; larger, user-upgradable hard disks; and a new trackball.

The Versa E, with front-mounted trackball.

The Versa E series notebooks are available with either an SL-enhanced 486DX2/40 or 486DX2/50 CPU, have hard disks ranging from 120MB to 340MB, have 4MB of RAM expandable to 20MB, and can have either monochrome or active-matrix color 9.5-inch screens. They each come with a removable 3.5-inch floppy disk drive, one Type III PCMCIA slot, and a new front-mounted trackball. Color models weigh 6.9 pounds, and monochrome models weigh 6.2 pounds. All notebooks can be upgraded to touch-sensitive pen screens (you can play Solitaire using your finger) that add 0.5 pounds to the weight. Battery life ranges from 5 to 7 hours for monochrome and 3 to 5 hours for color notebooks. Port replicators, docking stations, and cellular connections are available.
• List price: *NEC Versa E series, $2,899 to $6,029; NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-388-8888, 508-264-8000.*
Circle 410 on reader service card

BRIEFS

HARDWARE

protector for notebooks. The Note Book Pocket Protector has 58,000-ampere surge suppression and is available either in the 125-volt U.S. version ($64.95) or in the 120-/250-volt version ($79.95) for foreign travel. 800-225-4876, 508-655-1532.

EFI Electronics has its own notebook surge suppressor, the $89.95 LapTrax. It has a 4,000-joule rating, a clamping level of 300 volts, and a slot for a modem or fax line to protect that, too. But one of its biggest draws is its two-year warranty, which has unlimited coverage of fire and liquid spill damage, breakage, and even theft (up to $2,500), and is included in the price. 800-877-1174, 801-977-9009.

Presenter Plus Sound is **Consumer Technology Northwest**'s $495 (bundled with Asymetrix Compel) computer-to-TV converter with sound input and output capabilities. With it, you can add sound to presentations without a sound card. It plugs into a parallel port, has a jack for a microphone or handset, and can do audio playback in 16-bit WAV format. The $319 Presenter Video Capture ($399 bundled with Image Pals) connects to a parallel port; it can capture still video images and import them into a document from any video recording device. 800-356-3983, 503-643-1662.

DSP Solutions has released the PORT•ABLE Sound PCMCIA, a Type II PCMCIA sound card that can support programs written for the Creative Labs Sound Blaster. It can do 14-bit recording at 8 or 11 MHz, play back in 16-bit, and play MIDI or WAVE files simultaneously. It has OLE support and is available for $279.95. 916-621-1787.

SOFTWARE

If you want to find your way though the Internet, **Spry** offers the $149 AIR Navigator as a solution. This Windows-based suite of applications runs off any TCP/IP transport and includes AIR Mail, AIR Gopher, and AIR News, all to help guide you through the maze that is Internet. 800-777-9638, 206-447-0300.

IMPROVED

Document Manager Goes Beyond AutoCAD Files

Cyco International has released AutoManager WorkFlow 3.1 for Windows, a document management package that had its roots in handling AutoCAD files. Now it is branching out to embrace text file formats. The software tracks all documents and stores a history of the documents, updating it as needed. It has drag-and-drop capabilities and supports DDE. The Windows version is directly compatible with the DOS and the Sun Sparc versions, letting you have access to your database of documents across these platforms.
• List price: *AutoManager WorkFlow 3.1 for Windows, $795 per user. Cyco International Inc., 1908 Cliff Valley Way, #2000, Atlanta, GA 30329; 800-323-2926, 404-634-3302; fax, 404-633-4604.*
Circle 411 on reader service card

IMPROVED

More Multimedia from Tandy

Tandy Corp.'s Energy Star–compliant 1994 Tandy Sensation! Multimedia Personal Computer has been released. It has a 486SX/33 CPU, 4MB of RAM expandable to 64MB, a 3.5-inch floppy disk drive, a 212MB hard disk, three 16-bit expansion slots, one free 5.25-inch bay, a 9,600-/2,400-bps modem, and a monitor. The 1994 Sensation also includes local-bus video, SVGA graphics, a Creative Labs Sound Blaster 16 audio card, a double-speed CD-ROM, and MIDI and joystick ports. Tandy bundles MacroMedia Action!, Lotus Organizer, WinMate, CheckFree, Intuit's Quicken for Windows (Special Edition), CompuServe Start-Up Kit, and Worldshop Online Shopping service with the unit.

a shining example of the power the Windows interface has to make a complex activity easy to learn and productive to use. There are many b...

—*Computer Technology Review*

Accounting software developers have tried to do the impossible for years; wrap an intuitive simple, flexible interface and feature set around the rigid, cumbersome, complex process of double-entry bookkeeping. Peachtree Software's recently unveiled Release 2 of Peachtree Accounting for Windows ($169) succeeds. Even when you consider its for...

— *PC Magazine*

the program now uses less accounting jargon than the previous version—a real boon for the typical small business person. Other standout features i... well-int...

—*Compute*

ease of use starts with the "Friendly Accountant" (a little guy in a green eyeshade!) that walks users through setup and installation, and Smart Guides that help explain data fields and eases users into the program and accounting in general.

—*Computer Technology Review*

more intuitive and full featured than any similar product I've seen. T... program's new look incorpo...

—*Compute*

PAW offers General Ledger, Accounts Receivable, Accounts Payable, Payroll, Inventory, Job/Project Tracking, Financial Report Writer, Custom Forms Design, Bank Reconciliation and Import/ Export. With its use of the MDI (multiple document interface) specifications, any and all of these modules can be open at once, each automatically updated as changes are made in any other. The pr...

—*Computer Technology Review*

The best-selling Windows accounting software.

—*As Reported In PC Week.*

A dramatic new interface, new help functions and, more flexible, powerful money management functions make it hard to beat for small business accounting.

— *PC Magazine*

...duct I've seen. The program's new look incorporates state-of-the-art Windows conventions: descriptive icons, real-life representations of graphic forms, and visual flow charts that guide you through an accounting process.

—*Home Office Computing*

succeeds. Even when you consider its formidable competition, Peachtree's new cash management functions, ease-of-use features, and flexibility move the product ahead of the pack.

— *PC Magazine*

And it's multiuser straight out of the box. Peac...

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For a small business that's ready to upgrade from a checkbook pr...ram, Peachtree Accounting d...tely deserves a close look. ■

—*Windows Magazine*

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20969 Ventura Blvd., Woodland Hills, CA 91364 818-710-9174 Price subject to change without notice.

• List price: *1994 Tandy Sensation!, $1,799. Tandy Corp., 700 One Tandy Center, Fort Worth, TX 76102; 817-390-3300.*
Circle 412 on reader service card

NEW

Express Buses from BusLogic

BusLogic has released three new IDE caching controller kits: one for VESA, one for PCI, and the third for the ISA bus. All three let you configure up to four hard disks of 4GB each, as well as two floppy disks, and all provide disk mirroring and linking. Caches range from 512K to 16MB, and the average seek time is 0.3 milliseconds. The controllers for PCI and VESA offer 32-bit driver support for running enhanced DOS/Windows, NetWare, OS/2, or Unix; have a maximum I/O bus speed of 50 MHz; and support data rates of 5MB per second on the IDE disk subsystem with 20MB per second on the system bus. The ISA controller has a data transfer rate of 5MB per second and a maximum I/O bus speed of 12 MHz.
• List price: *KT-410A for VL-bus, $175; KT-910A for PCI, $255; KT-510A for ISA, $105. BusLogic Inc., 4151 Burton Dr., Santa Clara, CA 95054; 408-492-9090; fax, 408-492-1542.*
Circle 416 on reader service card

NEW

Fun with Dick, Jane, and Program Manager

Edmark has a way for you to encourage your children to use and become accustomed to computers while safeguarding your data and applications. The new KidDesk Family Edition for Windows lets each family member have a personalized desktop loaded with the applications they use. Access to other family members' desktops or to Windows and DOS is restricted.

Customized desktops with clear picture icons let even preschoolers use KidDesk.

BRIEFS

SOFTWARE

NTV, from **Peregrine Systems**, is a multimedia and videoconferencing product based on Video for Windows and designed to run on a network. It lets you turn your applications into groupware, letting other users on the LAN or WAN access your information interactively, and can send audio or video signals to different locations. It's priced at $299. 619-431-2400.

IBM Corp. has released IBM AntiVirus/DOS 1.04 and IBM AntiVirus/2 1.04. Some new features include a GUI interface, a "fuzzy" scanning engine for better detection of known and unknown viruses, and automatic scanning. A LAN version is available and offers password protection, an administrator interface, and user control profiles. Single copies are $29.95; LAN products are available through site licensing. 800-551-3579

The British company **Neural Computer Sciences** has improved its NeuDesk with Version 2.11. This $595 Windows-based product guides you through the creation of a neural net and can now handle more data. Two new $175 optional algorithms can optimize neural nets for certain types of problems like forecasting and classifying data. 44-0-703-667775.

Pacific Software Publishing has released KanjiWORD 2.0, one of the first Japanese/English word processors that works in Windows. It includes changeable resume, invitation and letter samples in Japanese, and a 50,000-word dictionary to help you compose documents in Japanese. Dialog boxes can flip back and forth between Japanese and English with a mouse click. The introductory price is $199, after March 1, the company will change this to the standard price of $249. 800-232-3989, 206-232-3989

Super Cursor is **Intelligent Voice Solutions**' answer to the black-and-white cursor. It comes with 200 cursor designs in 16 colors and lets you create your own. The cursors can even be animated. Super Cursor is available for $29.95. 407-658-2572.

The adult section of the program lets you control the setup of each desktop and is protected by a three-key combination and a password.

The program has a notepad, a calendar, a calculator, an address card file, and even a mailbox system. The interface is completely graphical, so even children who can't read can use it. Nameplates, desktop designs, and picture editors help customize each desktop to each user's tastes. There's also a multiple application mode for running more than one program at a time.
• List price: *KidDesk Family Edition, $59.95. Edmark Corp., 6727 185th Ave. NE, Redmond, WA 98073; 800-426-0856, 206-556-8400; fax, 206-556-8998.*
Circle 415 on reader service card

IMPROVED

Reinventing the Color Wheel

Color Wheel v 1.1, Release 2.0, from **Pacific Gold Coast Corp.** now has painting, image-processing, and video-editing capabilities. It lets you create and edit text as objects, add text to video frames, and perform the usual assortment of image special effects like blurring and mirroring. In addition, it lets you make changes in one frame of a video clip, then carries out those changes automatically on other selected frames. This object-oriented graphics software supports 24-bit color, OLE, .AVI, and .FLC/.FLI file formats.
• List price: *Color Wheel v 1.1, Release 2.0, $249; upgrade, $124. Pacific Gold Coast Corp., 15 Glen St., #201, Glen Cove, NY 11542; 800-732-3002, 516-759-3011; fax, 516-759-3014.*
Circle 414 on reader service card

NEW

CYMA's Back with New High-End Accounting Ideas

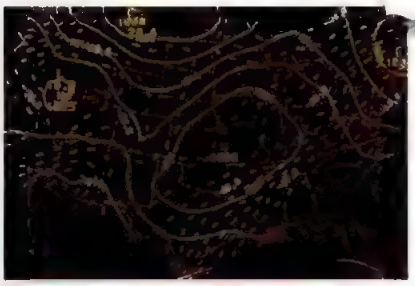
CYMA Systems is back from something of a hiatus with CYMA^{IV}/Accounting for Windows. The product consists of a series of interoperable modules that can be opened simultaneously. In addition, the software can post to the CYMA DOS-based PAS^{III} General Ledger, has Btrieve file structures, and has user tracking and security features.
• List price: *CYMA^{IV}/Accounting for Windows: System Manager, $795 to $1,895; other modules, $795 to $1,295 each. CYMA Systems Inc., 1400 E. Southern Ave., Tempe, AZ 85282; 800-292-2962, 602-831-2607; fax, 602-345-5703.*
Circle 403 on reader service card

Use The Internet Like A Pro.

Navigating the Internet Just Got Easier with WinGopher

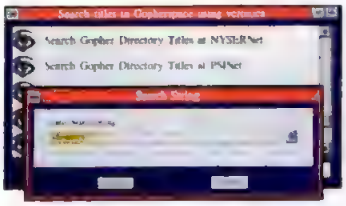
Have you wanted access to the Internet without the hassle of typing complicated addresses or memorizing file locations? Do you lose valuable time wandering through a maze of servers and unwanted files? Now you can organize and simplify your Internet access with WinGopher,™ a Microsoft® Windows™-based Gopher client.

Requirements for Gopher Clients	WinGopher
Uses Gopher Protocol	✓
Installation Support	✓
Users' Guide and Online Help	✓
Includes Text and Image Viewers	✓
Supports Windows Sound and Video Viewers	✓
Supports Phone Books	✓
Enhanced Bookmarks	✓
Views Multiple Open Servers	✓
Supports Winsock Compatible TCP/IP Stacks	✓
Microsoft Windows Interface	✓



View multiple servers at one time.

WinGopher provides you with a graphical interface that uses pull-down menus and point-and-click functionality for easy Internet navigation. Using the Gopher protocol, WinGopher supports Archie, Veronica, and WAIS searching. FTP transactions and Telnet sessions are supported, as well as any Windows sound or video viewer. An image viewer and text viewer are included with WinGopher.



Pop-up windows make searching easy.

Why WinGopher?

WinGopher is a fully supported product, including installation phone support, user documentation, online help, and an E-Mail bulletin board service. Backed by a leading automation firm, you're not left stranded should you need assistance.

Microsoft Windows Compatible

MICROSOFT WINDOWS COMPATIBLE

WinGopher works with other Windows applications and requires:

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WinGopher

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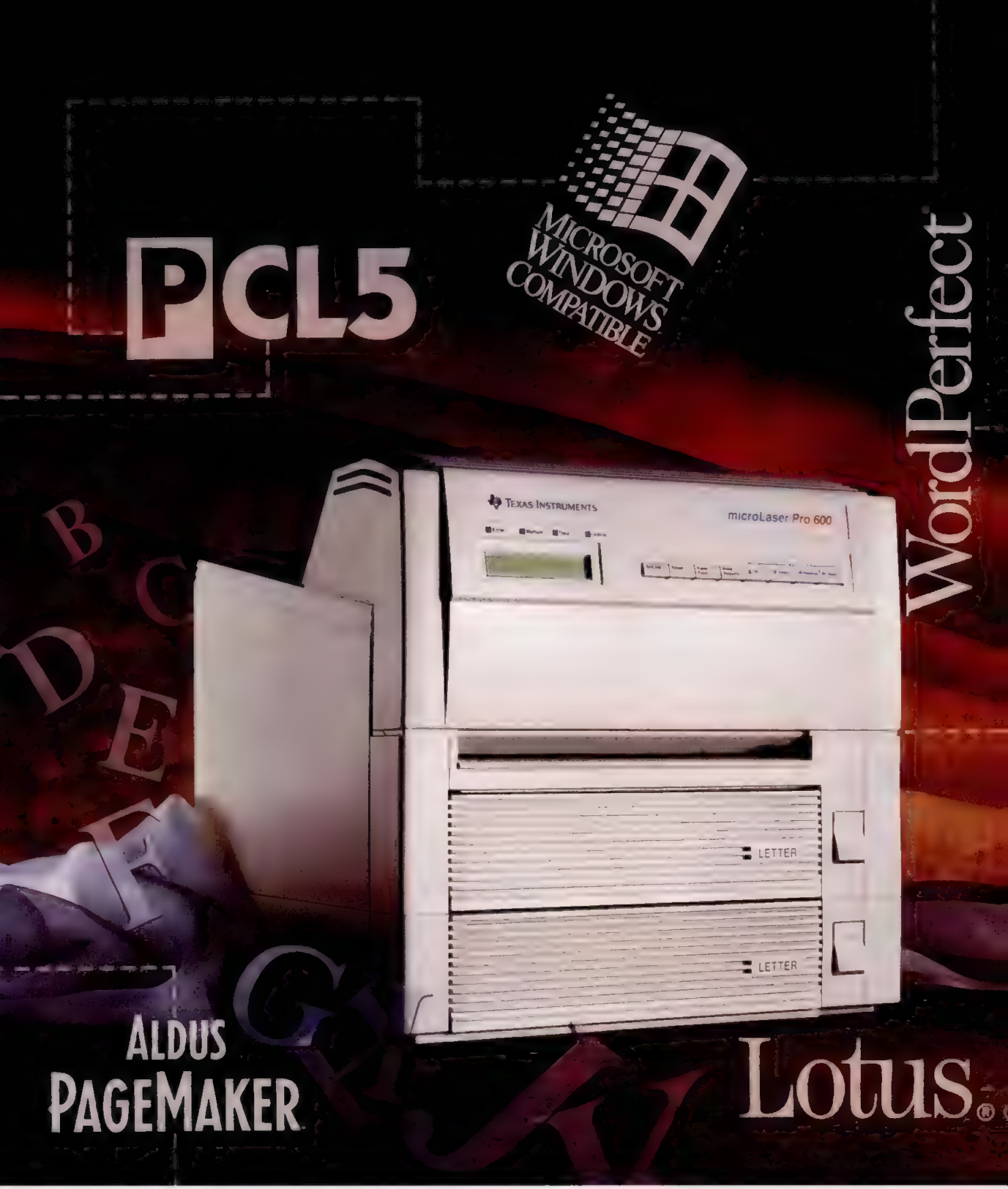

PC MAGAZINE EDITORS' CHOICE

*Specifications in chart are based on information as of 11/93. *Estimated dealer price including manufacturer's rebate is under $1400. Dealer prices may vary. †@ 4% coverage. ††Rebate applies to PS23 model. Software products illustrated above are not included with printer, and are intended only to indicate compatibility. microLaser and "Extending Your Reach With Innovation" are trademarks of Texas Instruments. Adobe PostScript and the PostScript logo are registered trademarks of Adobe Systems, Inc. WordPerfect is a registered trademark of WordPerfect Corporation. PageMaker is a registered trademark of Aldus Corporation. Lotus is a registered trademark of Lotus Corp. The Microsoft Windows logo is a registered trademark of Microsoft Corporation. Mac is a registered trademark of Apple Computer, Inc. LaserJet is a registered trademark of Hewlett Packard, Inc. © 1993 TI*

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	TI microLaser Pro 600	HP LaserJet® 4	HP LaserJet 4M
True 600 dpi	Yes	Yes	Yes
Memory	6MB	2MB	6MB
Emulations	PCL5/Adobe® PostScript® 2	PCL5E	PCL5E/Adobe PostScript 2
Compatibility	DOS/Mac	DOS	DOS/Mac
Toner Cart. Life	15K pages†	6K pages	6K pages
Paper Trays	250 sheet/250 sheet	250 sheet/100 sheet	250 sheet/100 sheet
Auto Language Switching	Yes	No	Yes
Auto Interface Switching	Yes	Yes	Yes
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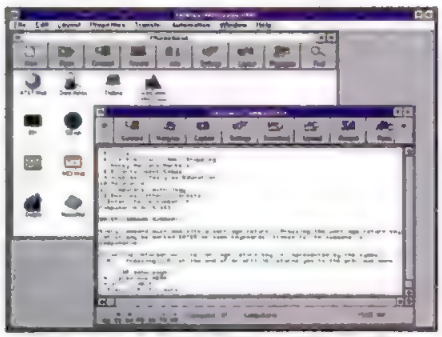

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WinFax PRO - the best way to send, receive and manage faxes

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CIRCLE 250 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Lance Ulanoff

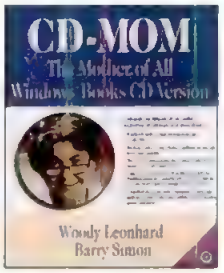
Extracting the Most from Microsoft Windows

BY J. W. OLSEN

Despite promised ease of use, Microsoft Windows is complex. And despite the wealth of details within Windows documentation, answers to questions can be elusive. So we sifted through some of the latest third-party Windows books for solutions. Some are for people who read Windows tutorials and others are for people who don't.

EVERYTHING . . .

Two entries stand out: *CD-MOM: The Mother of All Windows Books* by Woody Leonhard and Barry Simon, and *The Windows 3.1 Bible* by Fred Davis. Each is well illustrated and comprehensive. But similarities soon end.



Davis's *Windows Bible* begins at the very genesis of Windows 3.1 with a historical perspective and progresses through "Hacker Tools and Hints." While the *Windows Bible* holds your hand as you gingerly wander the Windows world, *CD-MOM* assumes you have lived there awhile and concentrates on productivity: What applet, for example, might help you complete a project? To extend the metaphor, the *Windows Bible* is useful for you as a Windows toddler or at any stage thereafter, growing with you throughout life. By contrast, *CD-MOM* expects you to be at least a Windows adolescent.

Writing styles are distinctly different. Both books provide comfortable exploration of often complex topics, but Davis's conservative style is the opposite of Leonhard's and Simon's, which bombards you with whimsy, irreverence, and humor. If *CD-MOM*'s personality delights you, she'll captivate you; otherwise, the jokes, puns, and cartoon characters may distract from the substance.

The *Windows Bible*'s rather pedestrian disk provides fonts, icons, and odds and ends—though it contains Paint Shop Pro, an exemplary graphics program. The disk is free ($4 shipping) via a supplied postcard. (An interactive CD-ROM version of the *Windows Bible* is also available for $34.95.) By sharp contrast, *CD-MOM* arrives with an exceptional CD-ROM (or for $10 less, you can purchase a version that comes with two, less feature-filled, 3.5-inch floppy disks). Simply put, the CD-ROM is alone worth the cover price. It puts competitors to shame. Beyond some shareware, fonts, and drivers, the menu's 9,000 files abound with scrumptious delights like working models of 18 notable applications, including Lotus's Ami Pro and cc:Mail.

- **CD-MOM: The Mother of All Windows Books,** *by Woody Leonhard and Barry Simon, $49.95 (includes CD-ROM). Addison-Wesley Publishing, 617-944-3700. ISBN: 0-201-62708-6.*
  Circle 446 on reader service card
- **The Windows 3.1 Bible,** *by Fred Davis, $28. Peachpit Press, 800-283-9444. ISBN: 1-56609-015-6.*
  Circle 447 on reader service card

. . . AND THEN SOME

If you're too busy (or intimidated) for everything-you-wanted-to-know books about Windows, you have two choices when you need help: a Windows guru at your beck and call or reference books. Here are two titles for those of us without a guru.

The 1,000-page *Windows Magazine Encyclopedia for Windows*, by the Eddy Group, complete with extensive illustrations, provides beginning and intermediate users with concise, usable explanations. If you thought that the MouseInDosBox= entry in your SYSTEM.INI had to do with a better mousetrap, the *Encyclopedia* sets you straight. More complex subjects, such as all those odd icons and menu choices in Paintbrush, are tackled in lengthier discourses (six pages for Paintbrush).

Packed with illustrations and helpful charts, John Woram's *Windows Configuration Handbook* rescues intermediate and advanced users facing challenges when configuring or troubleshooting Windows. Most chapters have four parts: overview, configuration issues, troubleshooting, and a guide to those beloved error messages.

The *Handbook* initially exhibits an identity crisis, with nearly 100 pages digressing into Microsoft DOS 6.0. Appropriately labeled chapter zero, this section will seem to you either immaterial or a bonus, depending on your interest in DOS 6.0.

Thereafter, Woram quickly reaches full speed, dissecting issues surrounding the Windows desktop, the StartUp group, the File Manager, the DOS window, the Clipboard, printing, fonts, and .INI files. Control Panel and memory—central to configuration and troubleshooting woes—receive extended treatment.

You won't read either book cover to cover, but that's not the authors' intent. For immediate answers to questions, though, these titles fill the bill well.

- **Windows Magazine Encyclopedia for Windows,** *by the Eddy Group, $29.95. Prima, 916-786-04261. ISBN: 1-55958-213-8.*
  Circle 449 on reader service card
- **Windows Configuration Handbook,** *by John Woram, $34.00. Random House, 800-733-3000. ISBN: 0-679-79113-2.*
  Circle 448 on reader service card

Read Only Recommends

From the bridge of the starship *Enterprise* to your bookshelf comes *Star Trek: The Next Generation—20th Century Computers and How They Worked*, by Jennifer Flynn. This book is a perfect marriage of Trek-o-mania and the nuts and bolts of computing in our times. $18.00. Alpha Books, 800-428-5331. ISBN: 1-56761-257-1.

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Maximum Resolution	1024x768	1024x768	1280x1024
Maximum Refresh Rate at Maximum Res.(Hz)	76	76	60
MPR-II (Low radiation)	•	•	•
Power Management	•	•	•
Flat Square Screen		•	•
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Michael J. Miller

Chicago Facts, Not Fiction

By now you've no doubt heard or read in one of many computer publications about Microsoft's "Chicago" project, the long awaited successor to Windows 3.1. And you may be asking yourself, "Why haven't I seen a 'preview' or even a screen shot of Chicago in *PC Magazine*?"

The reason is simple. Chicago is still a long way from being a real product. It isn't even slated to be released until the second half of 1994. As I write this (and most likely as you read this), Chicago is not even in formal beta testing. The user interface in the current developer's kits is expected to be completed changed. Most of what you've seen to date is a product of the Microsoft hype machine. That's where Microsoft marketing executives ask some people to sign nondisclosure agreements, then look the other way as the information is "accidentally" leaked to others.

BLACK BOX

It's not even completely clear which features will be in the next Windows box. The Chicago project contains a lot of interesting technology, but Microsoft has yet to decide how to package it. Yes, you should expect to see a "Windows 4.0" or something like that, but other elements such as networking may or may not be a part of the base package.

Still, Chicago has a lot of interesting ideas, and with the release of a formal software developer's kit during a recent Professional Developer's Conference, the time is right to start discussing them.

The most important thing to understand is that Chicago is neither a simple upgrade of Windows 3.1 nor a scaled-back Windows NT. Microsoft says that it plans to continue development of both a mainstream operating system aimed at 85 percent of the users (Windows 3.*x*/Chicago) and a high-end operating system aimed at servers and high-end workstation applications (Cairo, code name for the next version of Windows NT, is scheduled for release in 1995).

Is this the way the next Microsoft Windows interface will look?

AT LAST

Most of what is in the Chicago release won't come as much of a surprise: In most areas, other competitors have staked out this territory before. Basically, Chicago is a 32-bit, multitasking operating system—finally.

We've all been running 32-bit PCs for at least a half dozen years, but most of us, if we haven't been brave enough or crazy enough to run OS/2, Windows NT, or some Unix variant, have been stuck with 16-bit Windows. Chicago will have many new components, including a new 32-bit printer subsystem and a TrueType rasterizer, as well as new facilities for handling 3-D graphics.

All this is important because it allows for more powerful applications that can all be successfully run in the background. It means that new applications (those written to what Microsoft calls the "Win32 API") will be protected, can be preemptively multitasked, and can contain multiple threads. While this is true today for OS/2 or NT applications, it constitutes a major change for Windows applications.

Chicago is a full OS; it will not require DOS to run. Yet Microsoft says it will run all existing DOS applications and device drivers, as well as all of the existing Windows 3.1 applications and drivers. If Microsoft pulls this off, the new operating system will reach a level of compatibility none of its competitors have matched. (For those of you who don't want Windows, Microsoft expects to bring out a nongraphical MS-DOS 7.0 with the same core operating system as Chicago.)

WEB SLINGER

As you might expect, Chicago has a lot of changes on the networking front, building on work done in Windows for Workgroups.

Michael J. Miller

Chicago should be a "universal client," supporting multiple concurrent network drivers integrated directly into the user interface.

The "plug and play" initiative is being fully implemented in Chicago. This isn't a new concept; the Macintosh has done this for the past decade. But on the PC, it's a big step forward. In Chicago, the operating system will include a registry so that plug-and-play devices can be automatically installed and configured correctly. The system will keep track of all the devices installed and then arbitrate between them, assigning various system resources to each. Plug and play will accommodate ISA, PCI, and Micro Channel boards, as well as PCMCIA and SCSI devices.

You will see plug-and-play–ready machines and upgrade BIOSes before Chicago, but placing this capability in the operating system should make it simpler to use. All of this, of course, requires that hardware vendors support the standard, but just about every PC and peripheral vendor seems on board.

THE FACE THAT. . .

The biggest change, though, may be the user interface—and this is where the system is most "under construction." Although the final user interface is still not in place, many of the outlines are clear. The functions of Program Manager and File Manager will be combined, although you should be able to use the system in a method similar to Windows 3.1. The *desktop* will become a place for storing *objects* such as programs or documents. A *system toolbar* at the bottom of the screen will give you quick access to common functions and let you quickly switch among applications. You'll be able to have long filenames; the old three-letter extension will be used to associate files with applications.

As a result, Windows will be more *object-oriented*, allowing you to organize files by tasks or in other ways. In short, it might appear similar in concept to OS/2's Workplace Shell or the Macintosh. However, we are still waiting to see the *real* user interface when it appears in the beta version of Chicago, which is expected shortly.

To developers, Microsoft is now sending the message that they should write to the Win32 and OLE 2.0 APIs. If they do this, Microsoft says their applications will run on Windows 3.1 (via libraries that let 32-bit applications run there), Chicago, and on Windows NT. It's a compelling story—and one that Microsoft has to tell well, particularly given the new object-oriented technologies being pushed by competitors such as Apple, IBM, Novell, and Taligent.

New capabilities are important, of course. However, they probably won't matter much unless the system runs well on the mainstream PC. Microsoft says its goal is to make Chicago run on a 4MB machine just as well as Windows 3.1 does (with the same applications). Until Chicago finaly ships, no one can judge Microsoft's success or failure, but the company certainly has some ambitious goals.

Our goals, on the other hand, have not changed: We always want to bring you the *facts* as they become available. So, yes, you'll be reading more (and more) about Chicago in *PC Magazine*, but never at the expense of accuracy. Stay tuned: The closer Chicago gets to being released, the more we'll have to say. □

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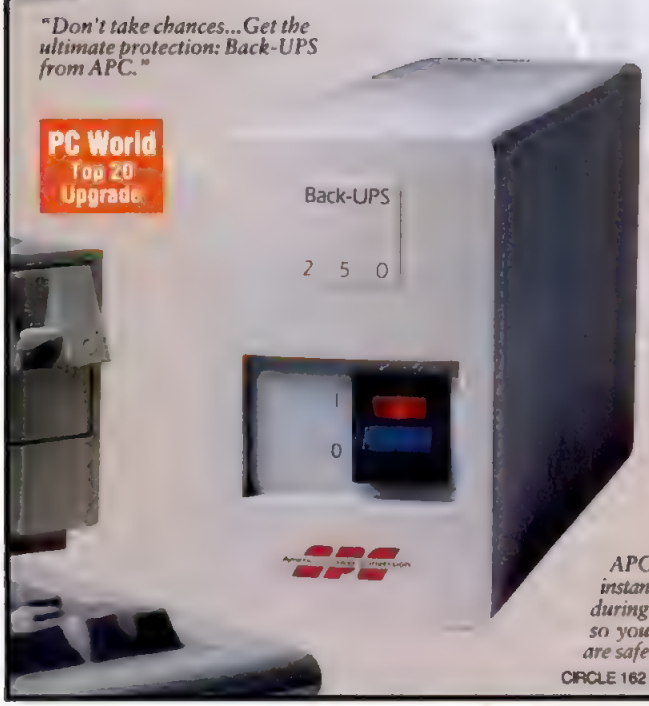

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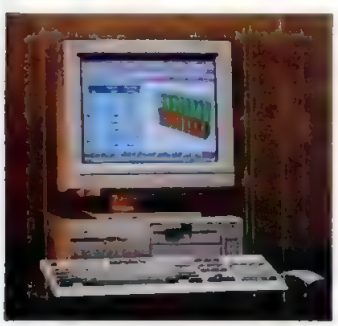

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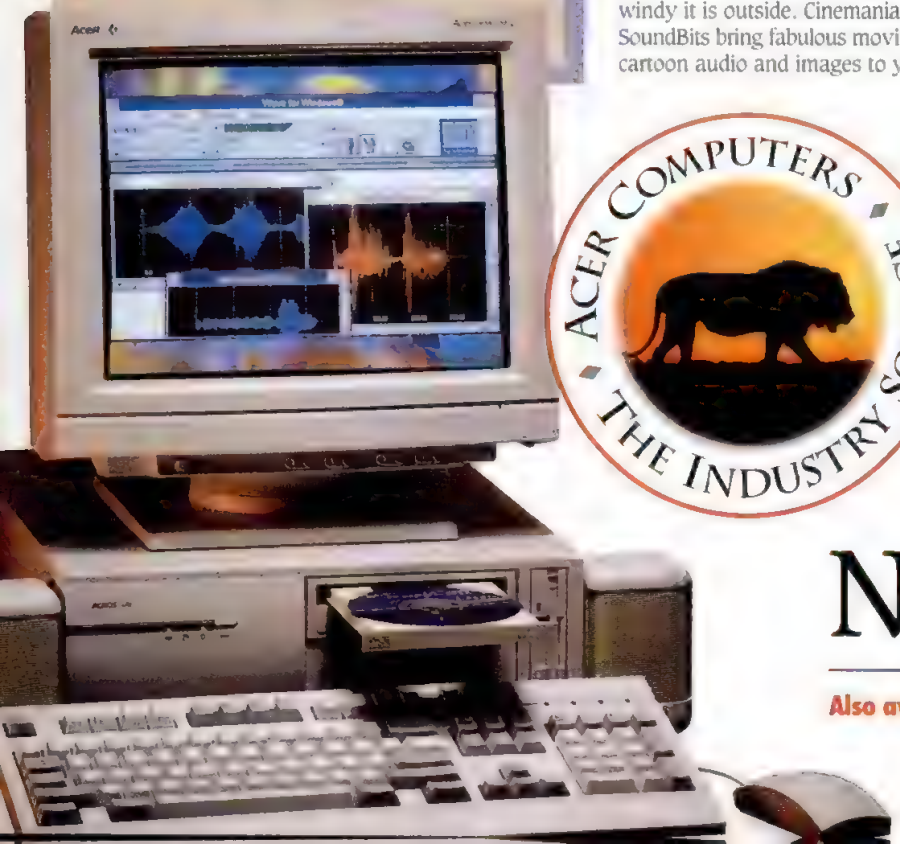

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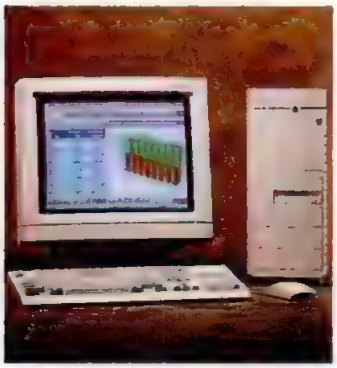

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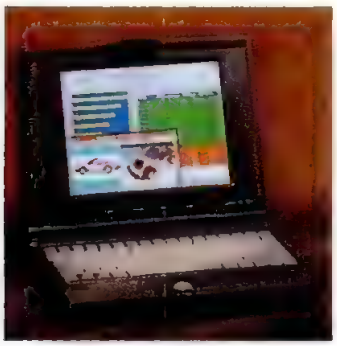

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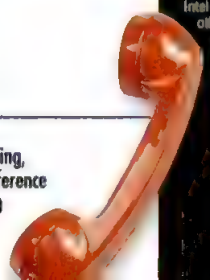

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Bill Machrone

Paperless Paper Shuffling

My wife hates it when I change things on her computer. I try to leave it alone, but every once in a while something comes along that I think will make her life easier. Compaq's Tabworks was one of these, and it wasn't a failure but it was a nonsuccess.

It certainly looked promising, with its tabbed, ring-binder metaphor. I would create a page for each of her activities: PTA, church, home, and so forth. Then I'd create a page for each of the kids, who use her machine for final output of school papers and the like. A couple of pages for games and applications and the machine would be incredibly well organized. Or so I thought.

Sharon's machine is loaded with text files. Most aren't more than a page or two long, but she's got hundreds of them. In this ostensibly paperless age, it makes more sense to leave them on the computer than in a filing cabinet. Besides, next year's memo to parents about pizza lunches looks a lot like this year's, which bears a strong resemblance to last year's. Many an evening, as we sit side by side at our computer desk (it occupies an 8-foot wall in the den), I hear her dark muttering about the impossibility of conveying significant meaning in an 8-character filename. Finding the file she wants is often a process of scrolling down a seemingly endless list of .DOC files in Microsoft Word for Windows' File Open window. What could be better, then, than to have like documents in one place, complete with a Properties window for each one that you activate with a click of the right mouse button?

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Installing Tabworks was no problem, but it would likely puzzle someone who is not a Windows expert. It comes up with tabs for Windows' default program groups only, so none of your applications are visible. You have to issue a specific instruction to get it to load the program groups. I did that, and added a few more tabs for the aforementioned categories. Then I hit the first snag: While opening File Manager and dragging the files onto the page is not difficult, they all look the same once they're on the page. Worse, the icon spacing is off—the names touch each other. Since the 8-character filename probably doesn't tell you enough about its contents, you have to open it, look at it, go back to Tabworks, bring up the Properties window, and change the title to something comprehensible. Thus PTABDLT3.DOC becomes "PTA Board Letter re: Snow Cleaning," or just "Snow Cleaning." Tabworks wraps the title nicely under the icon. The icon itself is just a waste of space unless you use the Properties feature to replace the generic icon with something more meaningful. Tabworks gives you a bunch of icons in a variety of colors that convey some sense as to the content; for instance, there's a spreadsheet, a letter, a graph, a blank page, and a Mondrian painting (honest, that's what it looks like!). While you can quickly categorize and color-code your files, unfortunately there's no provision to sort or group them by any of these properties.

I found it endlessly frustrating that Tabworks hides the file's date attribute. If you were using Tabworks from day one and didn't have to go through the laborious conversion process, it would be far more acceptable. If there had been a viewer utility, the conversion process would have been a lot easier. I found myself hankering for The Norton Desktop, which errs on the side of telling you too much but gives you many customization options. A melding of these products would be perfect. If I knew the date the files were created, I'd have a much better idea of whether they were what I was looking for without opening them in the application.

Somewhere between Tabworks and Norton Desktop is the perfect Windows file manager.

BUT WAIT! THERE'S MORE!

Any time I mention a product in these pages, it touches off a small deluge of information from people out there with similar products.

Illustration by Robert Neubecker

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Bill Machrone

"The Six-Stringed Computer" in our October 26, 1993 issue, was about guitars and computers and my experiences with a product called G-Vox. Since that time, I have discovered two more.

Scale Magic is an ambitious program aimed at a wide range of players. It teaches everything from basic chords to fancy scales and arpeggios. Scale Magic is based on sound musical theory and guitar practice: The on-screen fret board shows all of the "legal" notes in a given key and mode. Behind a song or riff is a set of arpeggio and scale exercises that will familiarize you with what your fingers are supposed to do. "Until they're hard-coded," says creator Gregory Billi. Then you can improvise rather than slavishly copy the riff or progression.

Scale Magic costs $89 and is available from SDGSoft (805-482-7291). Style modules for rock, country, blues, metal, and other styles are $19 each. Scale Magic can work through your PC speaker but sounds best driving a Creative Labs Sound Blaster or a MIDI synthesizer.

Chordmaster is similar in some ways, showing a representation of the fingerboard on the screen, but it adds a tablature window, too. It isn't as concerned with the underlying music theory as Scale Magic is—it gets right down to the playing. So whether it's the opening bars of "Layla" or a Bach bourrée, you just dive right in. Chordmaster lets you change the tempo while you're playing and switch between play-through and note-at-a-time steps.

Now, if it let me define areas to repeat, it would be perfect. But then I'm asking a lot of a package with a mere $20 registration fee. You can enter chords on the fretboard and Chordmaster will tell you what they are and give you different inversions and transpositions. You can order the Pro Plus version for $25 from Robert Watson, P.O. Box 2261, Monrovia, CA 91017-2261.

I should also mention that another old favorite, Band-in-a-Box, is now up to Release 5 and is available in a Windows version. This former finalist in *PC Magazine*'s Awards for Technical Excellence has shown steady progress over the years. In addition to creating decent-sounding accompaniments, it now plays melody and has song styles ranging from Jazz Swing to Miami Rock and Blues Shuffle. If you want your PC to sound like a decent lounge act, call PG Music at 416-528-2368. □

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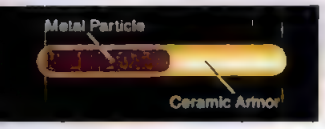

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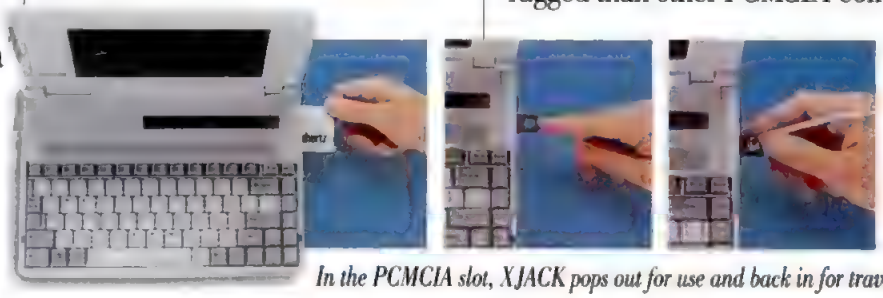

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ZEOS dual scan screen (left) fires up rich, vibrant colors while standard passive matrix screen (right) produces faded and dull colors. Photos are not retouched.

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John C. Dvorak

Dvorak's Annual Comdex Analysis

It's time to go over the 1993 Comdex catalog to look for industry trends. Every year I evaluate the Comdex *Program & Exhibits Guide* and compare its contents with those of previous years. It's my secret way to spot hot trends. So let's look at some of the trends we can extrapolate from the catalog.

The show couldn't keep up the record pace of the 1992 guide, which grew remarkably and broke all previous records. It soared past the thin 1991 guide, which was a mere 622 pages, down from a record 654 pages set in 1990. That record was shattered with a 724-page guide in 1992. The 1993 guide fell back to 706—nothing to sneeze at, but it could mark an industry downturn, too.

Most significant this year were two monstrous new index categories: Enterprise Computing and Mobile Computing. In 1992, there was only one major new category: Imaging. These aren't subcategories listed under something else. These are entirely new categories with a slew of subcategories under them. While Imaging hasn't declined by any means, these two new areas signify a trend away from the creative arts back toward business. Apparently, the boom in networking products resulted in the bursting forth of this new Enterprise Computing category. This is in contrast to the multimedia emphasis at the other end of the show. Folks, it seems to me as if this show is about to split in half like an amoeba.

The only major category to disappear from the catalog was Handheld Computing, which was replaced by Palmtop Computing (same thing, new label). And on an item-by-item basis, the show was fairly stagnant. The Accessories category, which includes the subcategories Acoustic/Dust Covers and Static Control Products, grew from 16 to 23 vendors for some odd reason. Is the workplace getting dirtier or what? I just don't get that category growth at all.

One big loser in the 1993 catalog was the category of Graphics Boards, which dropped from 81 vendors in 1992 to a mere 50 in 1993. The category peaked in 1991 with 87 vendors listed. I suspect the inclusion of an SVGA chip on the motherboard and the slowness with which the PC market is moving toward 24-bit color accounts for this trend. Then again, maybe the board people are abandoning the show. While Comdex wants to appeal to original equipment manufacturers (OEMs), many small OEMs can't afford to go to the show.

The biggest loser was the Motherboards/Daughterboards category. In 1992, there were 122 exhibitors, but this number fell off to 58 in 1993. This marks either a hiatus or a consolidation. The category Mass Storage: Disk Subsystems dropped from 44 to 25 vendors, while the category Mass Storage: Disks went from 28 to 34 vendors. Does this mean that there are fewer disk drive makers and that more blank disks are needed? Makes no sense at all. Export Services grew a bit, Artificial Intelligence declined from 8 to 5, and On-Line Services, still a poorly understood subculture, stabilized at 14.

This brings us to Mobile Computing and all its subcategories: Cellular Equipment, Communications Carriers, Dial-in Access Devices, External LAN Connectivity Products, Palmtops/Laptops, Portable Devices, and Wireless RF and FM Products. The total vendor count here is about 200.

Oddly, the new Enterprise Computing section simply restates almost the entire catalog with subcategories such as Portables, Routers, Servers, and Workstations. All of this seems rather redundant. I'm not entirely sure what's going on here, but this whole category seems bogus. Perhaps it's a signal that the show is trying to redefine itself. I suspect that the show's promoters are inventing new category names simply to lure teeming throngs of new conventioneers.

Enterprise computing, mobile computing, and multimedia attracted the most attention at Fall Comdex 1993.

Illustration by Robert Neubecker

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John C. Dvorak

Inside Track

How much **longer** can the 486DX2/66 dominate the desktop computer scene? The Pentium should be the chip of choice right now, but a number of factors have prevented this from happening. This includes the **shortage,** the price, and the difficult implementation of the chip. New factors may **further delay** the transition. Because Gateway 2000 is lowballing its Pentium machine, other vendors are unwilling to build and sell Pentium PCs when there is no profit in them. Many vendors who say they have Pentium machines for sale can't deliver in a reasonable time. Worse news: The **PCI specification** seems to be changing enough so that vendors know they'll have to replace PCI ROM chips in the future. They hate the idea and are worried about that prospect. This is going to be a **miserable** spring for the industry.

Future watch: One of the overlooked killer applications is language translation. In fact, we're not too far from being able to roam the world with a box that translates languages and speaks for us.

Meanwhile, PowerPC systems are starting to appear, but there doesn't seem to be much momentum building except over at Apple Computer, which is switching over to the chip completely in the next year or two. Insiders there are **stunned by the progress** the company has made on compatibility. One executive from a large company said, "If Apple can make it through the doldrums, it'll have the hottest computers on the market. You'll be amazed." Great, now what do I do?

So what's the deal with Cyrix and TI? To further confuse the market, we all expected Texas Instruments to start cranking out clones of the 486 based on some Cyrix work that was contracted between the two companies. TI sued Cyrix for breach of contract and Cyrix sued back for TI's failure to make enough wafers for Cyrix. This is a **screwy story** because a lot of people believed that Cyrix was a TI front, established to build 486 clones. If Cyrix was sued by Intel and lost, then Intel couldn't go after Texas Instruments and its deep pockets. You have to wonder, after all, where does any small company **get the resources** and talent to clone a chip as complex as the 486? Sheesh, even NEC can't do it with its billions. Whatever the case, Cyrix prevails over Intel and goes public. Indeed there is a TI connection as the two companies are going to share technology. Then suddenly there's this **odd lawsuit.** The whole thing could be a smoke screen for something else going on. But what else could be going on?

Latest Buzzword Dept.: If you want to wow them at the next cocktail party, mention a chip technology called **VLIW—very long instruction word.** This type of computer uses huge, complicated instructions per cycle. First CISC (complex instructions), then RISC (reduced instructions), now this. Can these guys make up their minds? This and other wacky concepts are discussed in the **excellent** newsletter *The Microprocessor Report* ($445/year, 707-824-4004). There you'll find excellent observations and odd claims such as the statement made by Motorola's Keith Diefendorff: "By 1997, most software will be portable, and once that happens the *x*86 will be dead meat." **Dead meat?**

Future Watch Dept.: According to the Xinhua Chinese News Service, Chinese computer scientists have developed an OCR system to scan and read **400,000 different Chinese ideograms.** It seems that machine translation of Chinese is just around the corner. In fact, machine translation is one of the most **overlooked killer applications** in the industry. Two companies, Globalink (Fairfax, Virginia; 703-273-5600) and Microtac (San Diego, California; 619-272-5700), make superb machine translation software for desktops. Personally, I find it peculiar that their phone numbers are so similar. Also note that Globalink is located near CIA headquarters in Mclean. Coincidence, right? Whatever the case, these companies make inexpensive systems that **actually work.** Most prevalent languages are supported. Anyone out there doing international business should have these systems on their machines.

The fact is we're not too far from carrying around **a box that translates languages** and speaks for us. We talk into a microphone in English and out of a speaker comes Spanish. IBM has already shown this technology, using its **continuous voice recognition system,** which the company's been **sitting on** for over a year. You talk into a microphone and it turns the spoken word into ASCII code, translates it into Spanish or Italian or whatever you want, and then speaks the words. It's tremendous. There's no reason why we all can't be roaming the world with a box that can talk for us. I suppose **the drawback** is that it might not understand the fast-talking Frenchman from Provence as he rattles off numerous options after we ask for a room with a shower.

More Humor off the Internet Dept.: It's amazing how many odd humorous anecdotes and jokes are passed around the Internet. This one came from the University of Washington (I think) and was found in the *Young Scientists Network Digest:* "The juvenile sea squirt wanders through the sea searching for a suitable rock or hunk of coral to cling to and make its home for life. For this task it has a rudimentary nervous system. When it finds its spot and takes root, it doesn't need its brain anymore so it eats it. It's rather like getting tenure." □

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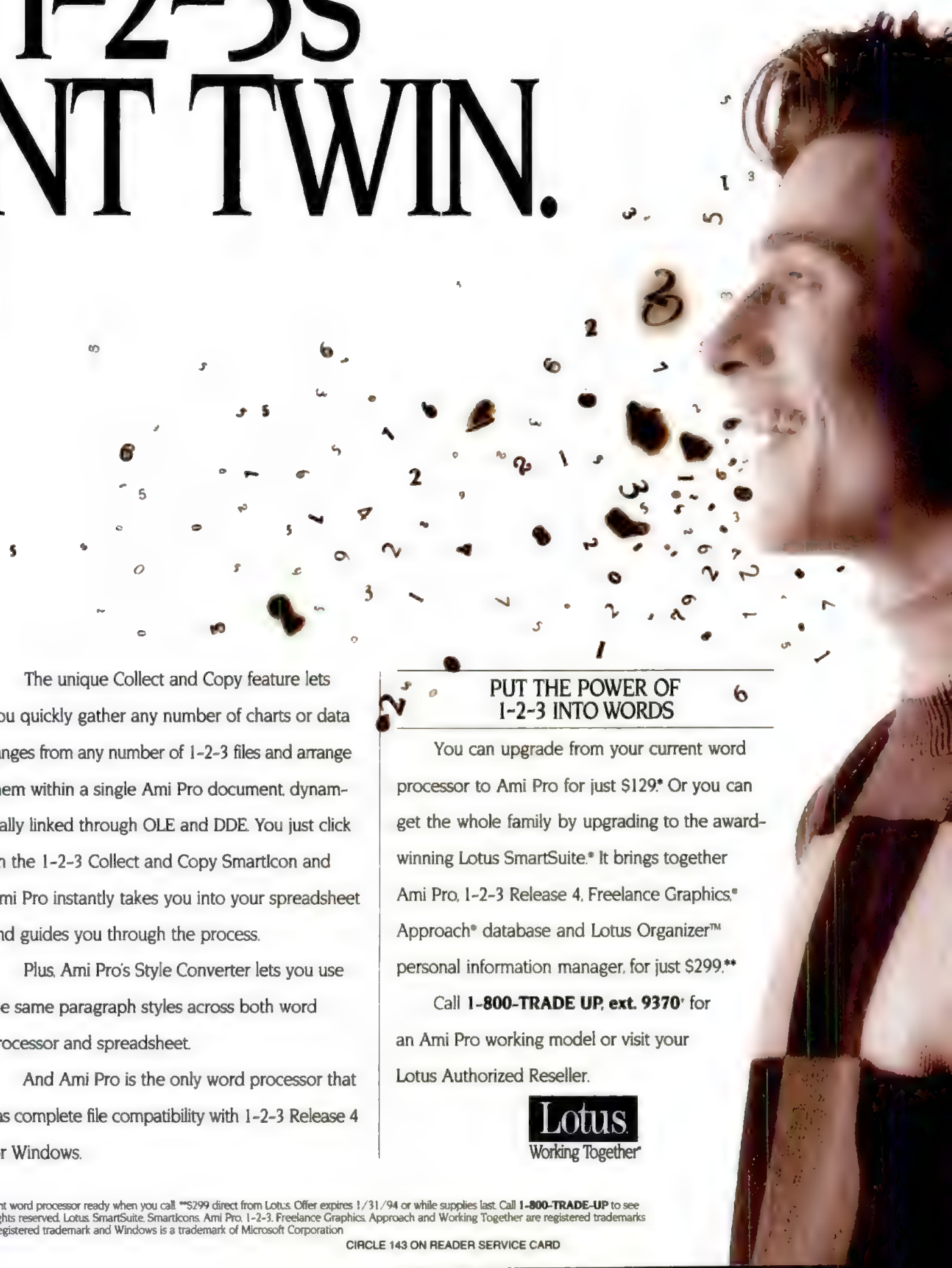

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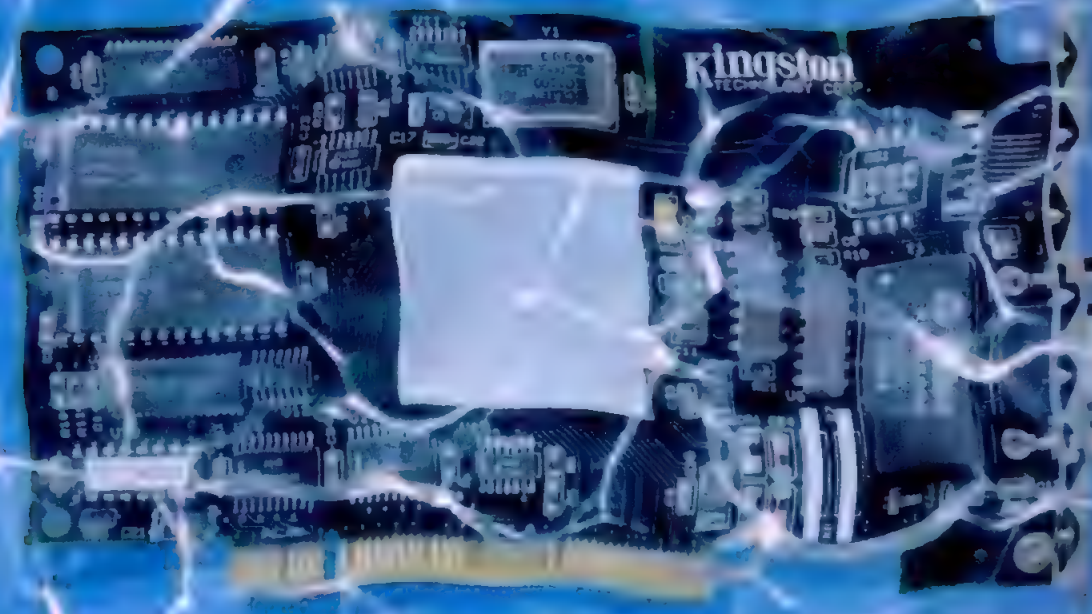

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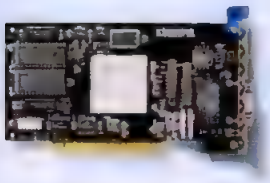

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THE INSIDE NAME IN UPGRADES

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Jim Seymour

The Service Bureau Scandal

Well, yeah, but which Mac program did it *start* in?" I gave up. We'd been down this path about ten times, and the service bureau tech on the other end of the phone Just Didn't Get It. . .and clearly wasn't going to. It was inconceivable to him that the desktop publishing file I was discussing with him hadn't come from a Macintosh application.

I'd called to see about getting repro film from an .EPS illustration of a complicated molecular model that had originated on an Evans and Sutherland graphics workstation, passed through about four other systems, and wound up as a PC EPS file.

I knew the file was okay because I'd pasted it into PC PageMaker, then printed the page on a PostScript-equipped LaserJet. I got the usual gray box on-screen from the EPS file, but the page printed normally, and the file was fine.

But the service bureau was wary, to say the least, about taking on the job and thoroughly confused. This was hardly the first time I'd run into problems with PC files at service bureaus; indeed, the Service Bureau Scandal, as I've come to think of it, has become a serious issue for PC desktop publishers everywhere.

The problem is that the service bureaus that turn computer files into paper or film for reproduction, 35-mm slides, or overhead transparencies almost always come out of the Macintosh side of the business. The Mac once *owned* desktop publishing, illustration, and slide-making, so it's not surprising that service bureaus are full of Macs and nice people who learned everything they know about computers on them.

But while the world has changed, few service bureaus have.

Today, PC-based systems are an important factor in desktop prepress. Though the Mac certainly will retain a significant share of this market, a swing to PC-based DTP is underway. The advantages in terms of both cost and raw horsepower are striking; bundles such as the Power Publishing Superstation package from Dell Computer, Adobe Systems, and SuperMac Technology make that advantage clear. When DTP is only part of the work to be done in an office (as opposed to the dominant function, as is the case with design studios), the efficiency of using the same PCs used for other work is even more clear. Finally, in some large firms, Macs are being mandated out by MIS, with *all* work going on PCs.

These factors have combined to build demand for service bureau output from PC files and apps. Yet the Mac-centric focus of most service bureaus continues, and very few PC-centric shops have opened.

TREATED AS A MAC FILE

Even if your friendly local service bureau does accept your PC app's output, there's a good chance it will be treated as a Macintosh file. That is, your PC PageMaker file will probably be read into a Macintosh and opened under Macintosh PageMaker. Or your CorelDRAW .CDR file will be converted to Adobe Illustrator format and opened on a Macintosh as an Illustrator file. The service bureau will then handle those files exactly as if they were Macintosh files.

Careful shopping can help you find a service bureau that meets your PC desktop publishing needs.

At first glance, this isn't all bad; after all, one of the advantages of PageMaker and other cross-platform apps is supposed to be the ability to move files back and forth more or less transparently.

But there are problems. The idiosyncrasies of Windows' handling of type fonts, for example, can lead to big trouble. And the proliferation of type vendors on the PC side (which has happened to a much smaller degree in the Mac world) means that you may have a font called, say, Rhonda, on your PC and in your file that doesn't match

Illustration by Robert Neubecker

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Jim Seymour

the metrics of the Adobe Type 1 Mac font called Rhonda that's installed on the service bureau's Mac system.

Your film or paper output is going to go seriously wrong.

There is a way around this, though it's primitive: Force PC PageMaker to dump to disk a raw PostScript file of each page with the fonts embedded in each of those pages. This is an incredibly tedious, page-by-page process, and if you have more than a few pages, it can drive you nuts.

PC users shouldn't be forced into such maneuvers. We should be able to deliver our files from Corel, Designer, PageMaker, and other native PC apps to the service bureau, confident that the bureau'll know what to do with them. And confident also that if problems arise—such as the dreaded "limitcheck" message from an image setter, the bureau will be able to open those files on a PC under the application that created them and fix the problems. Most service bureaus can't do that today. The latter point—a bureau's inability to open and fix a file in its native app, usually because the bureau doesn't *have* that application—is especially galling.

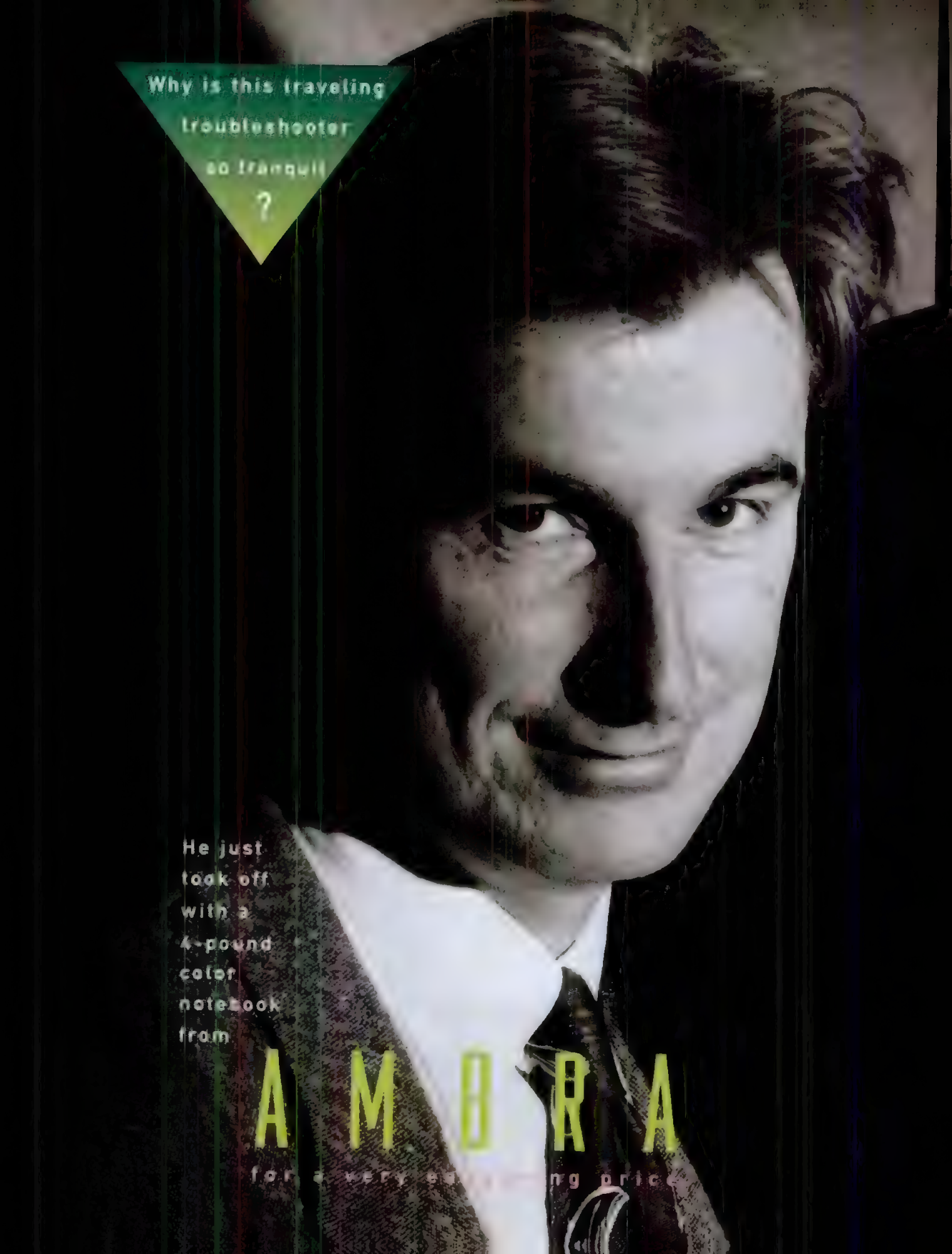
LOOK CLOSELY

The answer? Interrogate a service bureau you're considering using about its experience with PC files. Also, take a look around. If you see an ocean of Macs and a rusty old PC AT sitting forlornly in a corner, look elsewhere.

In fairness, things are getting better. Many Mac-oriented service bureaus will tell you they can handle PC output just fine—and some actually can now. We've also seen the emergence of some PC-oriented service bureaus, though they're still hard to find in many areas.

Corel has been identifying service bureaus that reliably handle CorelDRAW and other PC-application files for paper, film, and slide output. You can get that list (in the form of a Windows Help file) in the Corel forum on CompuServe. Search under the keywords *service bureau* in the Corel SIG. The list is also available on Corel's fax-back service: 800-772-6735.

Eventually, market demand will solve this problem. But not tomorrow, or next week or next month. Till then, protect yourself—and your work and reputation—by asking tough questions when you're shopping for a service bureau. □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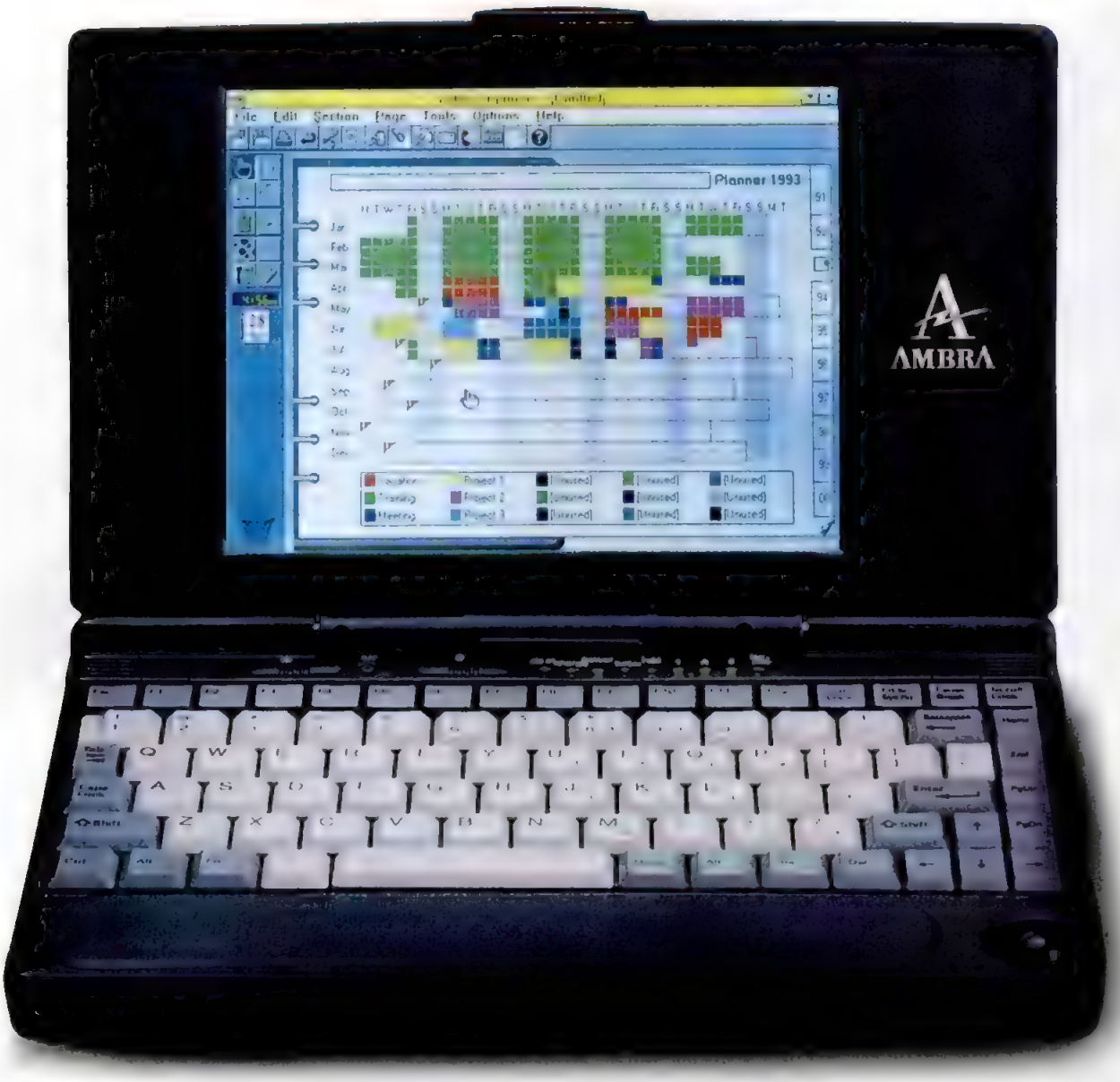

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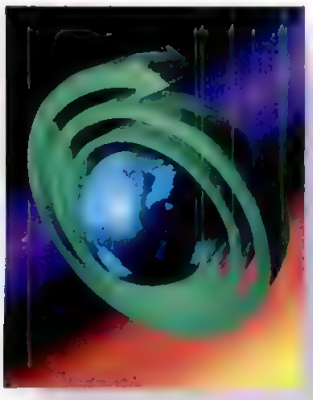

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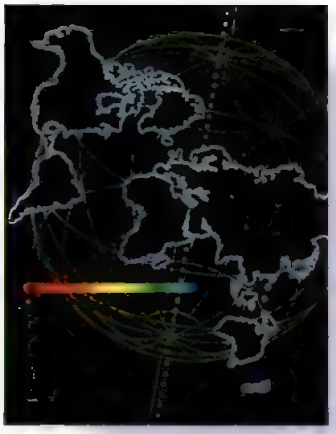

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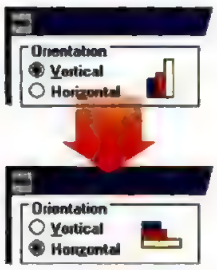

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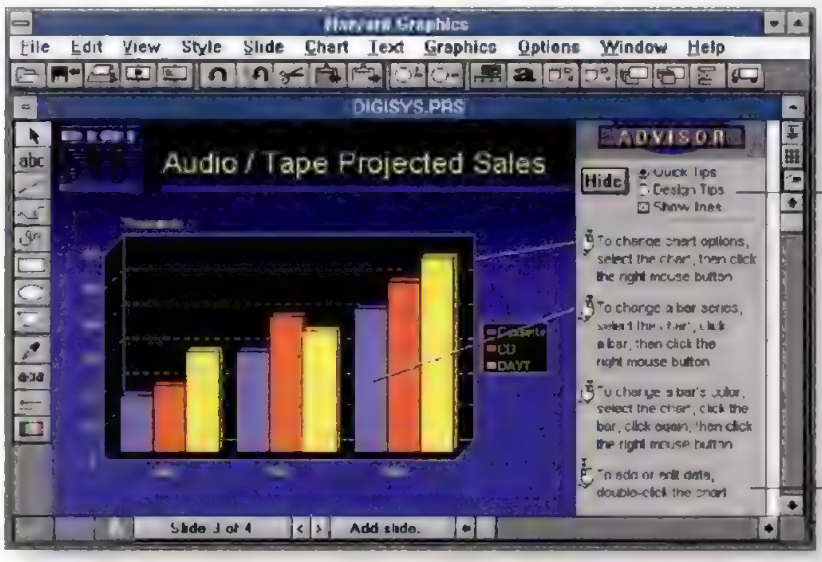

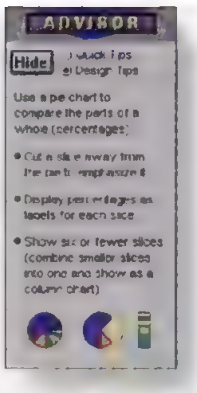

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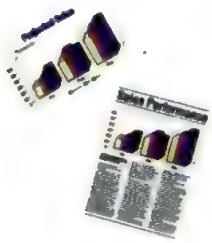

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Bill Howard

Buy Now, Buy Smart

Uncle Bob believes any car manufactured after 1975 is no good because of all that antipollution stuff. Cousin Tess wouldn't buy a color TV for 15 years because the technology wasn't good enough. Now Uncle Harry's daughter Susan and her husband are holding off buying a minivan until it has not just one but two airbags.

Today, the Tesses and Susans of the world are PC users and they're pondering whether to buy today or hold off until next year because of all the tantalizing changes that we'll see by year's end: plug-and-play PCs, Energy Star–compliant PCs, the Windows 4.0 (Chicago) operating system, and clock-tripled CPUs.

You don't need to wait. Here's what you can do to get the right PC and peripherals today and not worry about having an obsolete system 12 months from now.

Plug-and-play. Plug-and-play means your PC will recognize and automatically configure add-in cards and make sure the new cards don't conflict with the existing cards. You don't need a new PC to take advantage of plug-and-play. It will be easier if your existing PC has a flash BIOS so you can squirt in a plug-and-play BIOS, so if you're buying now, look for a PC with a flash BIOS. Your second choice will be to pry out the old BIOS ROM and replace it with a new one if your PC vendor does an update (only a handful of recent, high-volume PCs may offer this). Your third choice will be to utilize software patches that work with your existing BIOS.

Clock triplers. Sometime this year, Intel will ship 486-class CPUs that run at 33 MHz externally and 99 or 100 MHz internally. They'll have real-world performance similar to that of a 60-MHz Pentium system. Intel won't let PC makers advertise their systems as "clock-tripler–ready" because this new technology has not been officially announced. But you can ask if the motherboard is 3.3-volt–compatible (the 486DX3/100 CPUs will run at 3.3 volts). If so, it's likely you've got a match. Personally, I don't think you'll get enough performance improvement to justify the cost of replacing a 486DX2/66 or 486DX2/50 CPU, but that's your choice.

SCSI. The next version of Windows, whether it's called Chicago or Windows 4.0 when it ships in late 1994, will have SCSI support built in (as it already is under Windows NT, Unix, and OS/2), and that makes SCSI a lot more palatable. At the same time, IDE hard disks have broken through their existing 528MB constraint and now work well in 1GB configurations. So it's still a toss-up as to which standard is better; you can't go wrong either way. With prices below $1 per megabyte for many larger hard disks, I'd suggest 340MB for midlevel users, and 500MB or even 1GB for power users. Seriously.

Energy Star. Energy-conserving PCs and monitors will run at less than 30 watts each when idle. You won't be able to retrofit existing PC systems except with clunky power-off timers. But if you're upgrading an existing PC with a new monitor, some Energy Star–compliant monitors—notably Nanao and Nokia—will be able to drop to low-power mode if your PC has a screen blanker (meaning blank, not a bouncing-ball pattern). That can cut your overall power consumption in half.

Laptops with 8MB of RAM. Microsoft's goal is for the next Windows to use no more memory than Windows 3.1 does today. But it would be good insurance to buy your portable PCs today with 8MB of RAM, not 4MB, just in case. Extra memory always makes Windows run faster.

So, except for low-power system units, there's little you'll be able to buy at year's end that you can't approximate today. As for Uncle Bob, he's a lost cause. He finally bought a hard disk, but he's still running WordStar 3.3 on his 6-MHz PC AT and complaining he doesn't see much improvement over the CP/M days. □

Those fence-sitters waiting for just the right PC will get stuck with nothing but splinters.

Illustration by Robert Neubecker

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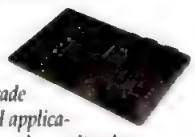

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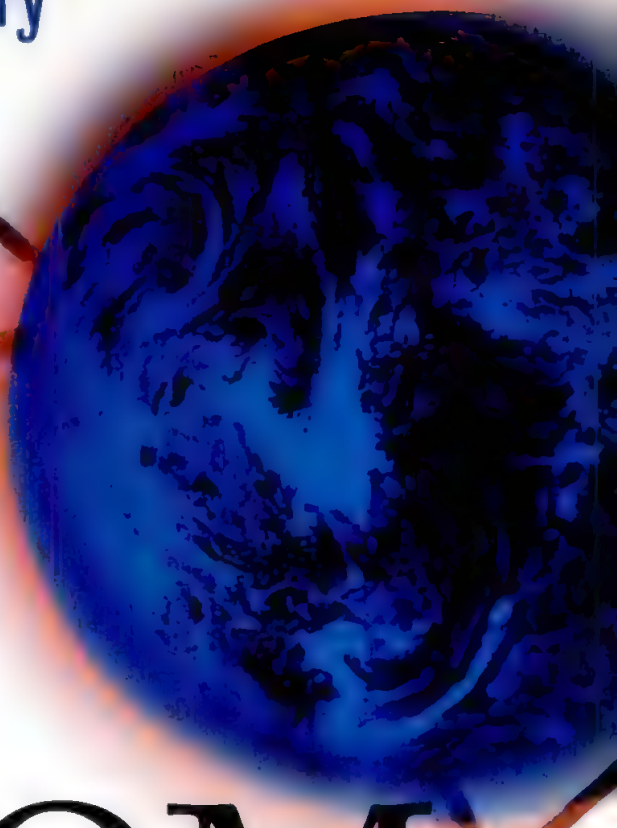
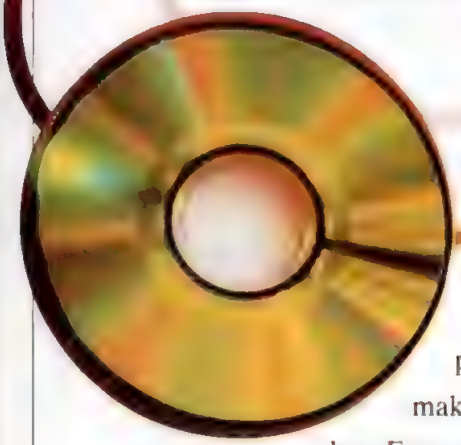
The World of CD-ROM





The CD-ROM drive has evolved from a luxury into an integral part of computing. In this issue, *PC Magazine* presents a practical look at how to make the most of your CD dollars. For our story "CD-ROM Drives: Going Mainstream," we report on our tests of 26 single-, double-, triple-, and quadruple-speed drives. "Sharing a CD-ROM" tackles the thorny problem of networked CDs. "A Photographic Memory for the Digital Age" explains how photo CDs are transforming photography. And finally, if you've ever considered publishing a multimedia CD-ROM, read "Creating Multimedia to Die For." Now is the time to take the CD plunge—the right way.—*Leon Erlanger*

Photography by Geoff Spear

CD-ROM DRIVES

Going Mai

Faster, increasingly less expensive, and bolstered by thousands of available titles, CD-ROM drives are quickly becoming essential components of personal computers. With prices for single-speed CD-ROM drives nudging the $200 mark, double-speed drives available for less than $400 (Sony's new budget double-speed CDU-33A should sell for $210 on the street), and triple-speed drives on the way, analysts expect more CD-ROM drives to be sold this year than in all previous years combined. According to CI InfoCorp, a market research firm based in Santa Clara, California, 1.15 million CD-ROM drives are currently installed in MS-DOS– and OS/2- based microcomputers in the United States. That figure is expected to double by the end of 1994 and to double again in 1995.

Storing up to 680MB of information on a single disk, CD-ROMs are now used for everything from multimedia games and reference titles to operating systems (Microsoft Windows NT) to graphics packages (CorelDRAW) to programming tools (Microsoft Visual C++). The CD-ROM is also an excellent medium for storing large amounts of textual information. Many information services distribute large amounts of data on CD-ROM disks, and, with the prices of some CD—recordable (CD-R) drives coming down to the $4,000-to-$5,000 range, several corporations are also using CD-ROM as a way of distributing information to employees.

REVIEW CRITERIA

To be included in this roundup, a CD-ROM drive had to meet the Multimedia PC Marketing Council's Level 1 Multimedia PC (MPC) specification of 150 kilobytes per second of sustained average data throughput; it also had to be shipping to customers at the time of the review. Last year, the Multimedia PC Marketing Council released its updated MPC Level 2 specification, which stipulates a CD-ROM drive capable of 300-KBps throughput—or double-speed drive performance. It also recommends that double-speed CD-ROM drives use no more than 60 percent of the CPU's processing power to transfer data (single-speed drives must use no more than 40 percent).

Mitsumi, Sony, and Tandy chose not to send their single-speed models for review, leaving us with three single-speed drives—the Chinon CDS-435, the Micro Solutions backpack (standard speed), and the Philips LMS CM215. In addition, the following drives did not make it in time for testing: the Mitsumi CRMC-FX001D ($199 to $299),

CD-ROM drives are quickly becoming as necessary as hard disks. PC Labs tested 26 drives, including the first triple- and quadruple-speed products, for everything from data throughput to multimedia playback. • *by John R. Quain*

nstream

Photograph by Geoff Spear

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Wearnes Beethoven SuperSpin CDD-110 154

Storage Devices External Parallel Port CD-ROM (single-speed, $699; double-speed, $899), the Todd Double Speed TCDR 2XMS ($915), the Todd Traveler TCDR 7700 ($795) and Todd Traveler TCDR 7750 ($915), the Toshiba TXM-3401P ($925), the Relax Vista Chinon CD-ROM ($459), the Procom CD Tower 4-DS ($2,795), and the NEC MultiSpin 4X Pro ($995).

The remaining 23 drives included here range from Sony's new budget double-speed CDU-33A, costing $269.90, to Pioneer's quadruple-speed jukebox player, costing $2,045. All prices include the adapter card. The most common drive mechanism appearing in this roundup is Toshiba's fast but pricey double-speed design, used in nine of the 26 models reviewed here. You'll also find proprietary drive mechanisms and those manufactured by Philips and Mitsumi.

TESTING: WHAT WE FOUND

This year, we've upgraded our CD-ROM drive tests to measure more than just data throughput. In addition to our Sequential Read test, we used Microsoft's MultiMedia Pack v.1.0 VidTest software to test CPU utilization and multimedia playback, and we evaluated each drive's performance on real-world tasks such as loading large TIFF (Tagged Image File Format) graphics files (of 8MB and 32MB) and doing simple and complex (Boolean) database text searches. Also for the first time, PC Labs tested each drive's ability to play back sound from a standard audio CD (Red Book audio).

All of the drives tested managed to meet the MPC Level 1 specification. Most of the double-speed CD-ROM players also managed to meet the MPC Level 2 specification (within 2 to 3 percent). The only exceptions were models that came with parallel-port adapters. Pushing data across a parallel port is a slow, CPU-intensive operation that acts as a bottleneck to the flow of data from the CD-ROM drive to the system. Parallel-port drives were significantly slower than other drives on Sequential Read and Text Search tests and performed poorly on our multimedia playback tests. We can recommend these drives only in situations where portability is the most important requirement.

In general, double-speed drives offer substantially better performance than do single-speed drives. The Chinon CDS-435 single-speed drive, for example, managed only about half the average data throughput of the double-speed contenders. Even for database-reference applications, the single-speed Chinon CDS-435 and Philips LMS CM215 took more than twice as long as did most double-speed drives to perform simple text searches. Double-speed drives also showed better perfor-

HIGHLIGHTS

CD-ROM Drives

DOUBLE-SPEED DRIVES are taking over. Of the 26 units tested, 21 offered 300- KBps claimed throughput, thereby conforming to the MPC Level 2 specification. With street prices for some double-speed models below $300 (including interface cards), single-speed units face rapid obsolescence.

PIONEER'S QUADRUPLE-SPEED six-disk changer was the fastest drive of the pack—and, at $2,045, one of the most expensive. NEC Technologies' just-released $725 NEC MultiSpin 3Xe proved to be a disappointment; the triple-speed unit performed on a par with the double-speed units but was more expensive than many. Among double-speed drives, the Chinon CDS-535 and the PLI CD-ROM MS were the best performers.

SMOOTH VIDEO PLAYBACK was a challenge, even for some of the fastest units. Fifteen frames per second of 320- by 240-pixel compressed video was more than most subsystems could maintain without dropping frames. Audio dropouts were a problem only for a few of the slower drives.

RED BOOK AUDIO QUALITY for these drives didn't measure up to that of consumer audio CD players. Only one drive—the Micro Solutions backpack (double-speed)—did justice to the compact-disk medium. Many units showed poor high-end frequency response and unacceptable distortion levels.

SCSI IS STILL the interface of choice for CD-ROM drives, and high-end adapters can boost performance. Parallel-port connections offer transportability and freedom from SCSI's configuration hassles, but their limited throughput is a serious bottleneck; parallel-port drives were consistently the worst performers on our tests. The best solution: the Liberty 115CDP, which offers both SCSI and parallel-port connectors.

mance in playing back multimedia clips, with fewer frames dropped. Of the double-speed drives, those using Toshiba and Plextor drive mechanisms seemed to show slightly better results than did others on all of our performance tests. Our tests showed that even among parallel-port drives, double-speed units have a performance advantage over single-speed units.

For most of the drives, Red Book audio performance ranged from poor to acceptable. None of the drives produced sound that approaches audio-CD sound quality.

MORE TURNS FOR CD-ROM DRIVES

NEC Technologies, the originator of the double-speed drive, recently upped the ante with the introduction of triple- and quadruple-speed single-disk CD-ROM drives. Based on the same principle as are double-speed models, the new NEC MultiSpin 3Xe and MultiSpin 4X Pro drives employ a faster rotation speed and decoding scheme to boost data transfer rates. Triple-speed drives are rated at 450 KBps, while quadruple-speed models are rated for data throughput of 600 KBps.

While the MultiSpin 3Xe showed appropriately fast throughput results, its scores were equivalent to those of the double-speed drives on our Text Search, multimedia playback, and TIFF Image File Load tests. Upcoming triple-speed products may show better performance. The $725 MultiSpin 3Xe should be available by the time you read this, and NEC expects to ship its quadruple-speed $995 MultiSpin 4X Pro early this year.

One quadruple-speed model is already available: the six-disk Pioneer DRM-604X CD-ROM changer. On PC Labs' Sequential Read test, its score was 586 KBps—by far the best score in this review—and its performance on our multimedia playback tests was excellent. Unfortunately, its $2,045 list price puts it out of reach for most individual PC users.

Large companies looking for an efficient way to distribute hundreds of megabytes of information should consider some of the lower-cost CD—recordable drives now available. In addition to CD drives from Eastman Kodak, JVC, Philips, Pinnacle Micro, and Sony, companies such as Microboards are offering CD—recordable bundles, which include software and blank CD-ROM disks, for as little as $3,900.

STANDARD WARS

Until recently, a raft of incompatible standards for CD-ROM drives bedeviled buyers. Lacking industry support, Tandy and Microsoft's VIS (Video Interactive Systems), Philips' CD-I (CD—Interactive, a hardware and software standard for bringing interleaved text, sound, and video to home entertainment systems), Commo-

EDITORS' CHOICE

- *High-performance, multidisk*.....**Pioneer DRM-604X**
- *General-purpose (SCSI)*.....**Chinon CDS-535, Plextor DM-3028 DoubleSpeed PLUS**
- *General-purpose (proprietary)*...**Sony CDU-33A**

With a street price of about $220—which includes a proprietary ISA adapter—the Sony CDU-33A is the best bargain among the 26 CD-ROM drives we tested. Its proprietary adapter lacks the flexibility of SCSI, but you get hassle-free installation and adequate performance.

The Chinon CDS-535, about $370 on the street with a Chinon 16-bit SCSI adapter, was the fastest double-speed model on most of our tests. The drive's one shortcoming: abysmal Red Book audio quality.

The Plextor (formerly Texel) DM-3028 DoubleSpeed PLUS, while not not quite as speedy as the Chinon model, was also an excellent performer; it had better Red Book audio results. At a street price of $368, which includes a Trantor T-130 8-bit ISA adapter, it merits consideration.

If you want high performance at any cost, then the Pioneer DRM-604X is the drive to buy. This six-disk changer captured the top spot on virtually all of our tests. The DRM-604X sells on the street for $1,300.

HONORABLE MENTION

Three double-speed drives did not earn an Editors' Choice but do deserve honorable mention. The Liberty 115CDP offers both parallel and SCSI connectors; the parallel connector lets you hook up to virtually any machine, and the SCSI connector means superior performance whenever a SCSI card is available. The PLI CD-ROM MS is a solid choice—one of the best performers on our tests. But its $700 street price is higher than that of the Editors' Choice Chinon CDS-535 that edged it out. The Reveal CDD12 stands out for its 12 included CD-ROM software titles and videotaped installation guide.

THE ALTERNATIVES

We didn't award an Editors' Choice to any of the three single-speed drives tested. Their performance was lackluster, despite prices higher than that of the Sony CDU-33A. Unless you can find one for well under $200, single-speed drives aren't worth your attention.

Parallel-port drives also proved poor performers. If you must select one, we suggest the Liberty 115CDP, which also offers a SCSI interface.

Our Contributors: CRAIG L. STARK is a staff editor and JOHN R. QUAIN is a contributing editor of *PC Magazine*. NICK STAM is the technical director for hardware at PC Magazine Labs. STEVEN C.M. CHEN, JOSEPH DESPOSITO, BILL DYSZEL, and GREG PASTRICK are frequent contributors to *PC Magazine*. HOWARD ALEXANDER and PATRICK HONAN are free-lance writers. LEON ERLANGER was the associate editor in charge of this story, and MICHAEL J. ZULICH was the project leader.

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dore's proprietary *CD-TV* standard, and Sony's *MMCD* (MultiMedia CD, created for Sony's hand-held Multimedia CD Player) formats all seem to be falling by the wayside. Most buyers needn't worry about the esoteric standards with color labels either—*Yellow Book* (the standard describing the manner in which data should be laid down on a CD-ROM disk), *Red Book audio, Green Book* (CD-I), and *Orange Book* (a standard for CD—recordable drives). All the models in this review play standard audio CDs, MPC titles, CD-ROMs conforming to the ISO 9660 file format, and disks based on Eastman Kodak's Photo CD format. All except the Chinon CDS-435 can read multisession disks (disks that have been recorded to in more than one session). This capability is useful if you want to periodically add Photo CD images to a disk or if you are using CDs for archiving data.

Photo CD has been gaining momentum. Several drive makers now offer bundles that include Kodak's $99 Shoebox utility for Windows. Software developer Corel Corporation is selling Photo CDs that contain 100 high-resolution photographs in the Kodak Photo CD format. And the $49.95 disks include a utility that enables you to access Photo CD images and *multisession* recordings even if your drive doesn't support the Photo CD or *CD-ROM XA* format (eXtended Architecture, which is a subset of CD-I that interleaves audio, video, and text). (See the Photo CD story "A Photographic Memory for the Digital Age" in this issue.)

In addition, industry calls for CD-ROM XA compatibility appear to be waning. You'll be hard pressed to find a CD-ROM XA title anywhere today, and even the MPC Level 2 specification requires only that a CD-ROM drive play back XA files—not XA's ADPCM (Adaptive Delta Pulse Code Modulation) compressed audio files.

SHOPPING CONSIDERATIONS

If you're in an environment where smoke and excessive dust are unavoidable, you may want to consider a drive whose mechanism is protected from the outside by double doors and a caddy design. On the other hand, the caddyless tray designs that operate like audio-CD players are more convenient, and most of the CD-ROM drives have self-cleaning lenses to keep them on the right track. In this review, 18 of the 26 drives use a caddy design. External drives tend to be slightly more expensive than internal units, but they are worth considering if you are short on drive bays. You can also easily disconnect an external drive from one system and reconnect it to another, as long as both systems have the right interface card.

Your PC also needs to meet a few basic requirements. To build a library of MPC multimedia titles, you'll need a 25-MHz 486SX PC or better with at least 8MB of RAM and a VGA display to meet the MPC Level 2 recommendation.

You should also have a sound card and a pair of external speakers or headphones. To play back audio CDs or CD-ROM products that use Red Book audio, make sure you can connect the drive's audio outputs to your sound card: Some portable CD-ROM drives, such as the NEC MultiSpin 38, don't have stereo audio output jacks for a sound board, while some sound cards lack an analog audio connection for an internal CD-ROM drive. The digitized .WAV files found in most multimedia CD-ROM applications are processed and sent through the system bus to the sound card, so they don't require a direct connection.

Unless you already have a SCSI host adapter in your PC, you'll also need an available expansion slot to accommodate the drive's controller card. If you want further expandability, consider that models requiring a proprietary interface generally lack the expansion abilities provided by SCSI adapters. And while you can, theoretically, network any of these drives (if you can find drivers compatible with your network operating system), a SCSI-2 configuration will generally provide better performance and compatibility than will other configurations. (See the article "Sharing a CD-ROM," also in this issue.)

Desktop users can save some money by connecting the CD-ROM drive to a sound card, assuming the board provides the right connector (SCSI or proprietary), but keep in mind that SCSI connectors on many sound cards don't allow you to daisychain other devices, and you may not get as good performance as you would by using the controller card packaged with the drive.

Installing the appropriate drivers and software extensions won't take much hard disk space—typically about 500K—but CD-ROM-based software will. Most reference titles require only 1MB of hard disk space to store navigation files and frequently used graphics, but some need as much as 8MB of hard disk space, and many of today's popular CD-ROM games take more than 10MB. The MPC Level 2 specification recommends that you have least a 160MB hard disk.

CD Technology Inc.

CD Porta-Drive Model T3401

BY STEPHEN C.M. CHEN

Despite its name, the CD Porta-Drive Model T3401 isn't any more portable than most external double-speed drives: It comes with a standard SCSI-2 connector, and its manufacturer, CD Technology, no longer sells a battery pack. But the Porta-Drive is strong on performance, though its $1,050 list price (which includes an 8-bit SCSI controller from Future Domain) is a bit higher than the average. (Street price for the drive is about $200 less.)

The Porta-Drive turned in solid scores on most of our tests—a hallmark of its fast Toshiba XM3401B mechanism. It struggled only on our most difficult multimedia sequence, where it dropped nearly two-thirds of the video frames. Red Book audio quality (for playing audio CDs) was about average.

The CD Porta-Drive Model T3401.

Installing the drive proved a straightforward task; the default settings worked right out of the box, and the drive's extensive documentation should help resolve any configuration problems.

CD Technology offers a variety of options for the Porta-Drive, including a 16-bit ISA or Micro Channel SCSI controller ($300 each). A $250 parallel-to-SCSI Adaptec adapter lets you connect the unit to a parallel port, so it's attach-

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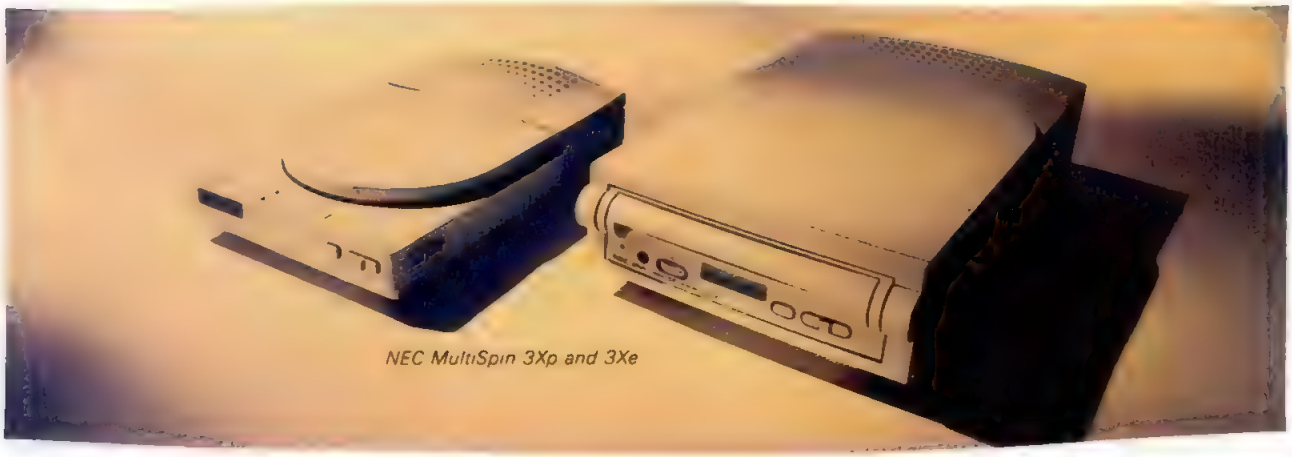

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able to virtually any machine. An internal version of the drive is also available for $700 ($900 with the tested 8-bit SCSI adapter).

The Porta-Drive supports CD-ROM XA and Photo CD multisession formats and includes a headphone jack with volume control. If you need to share a drive among several machines, the CD Porta-Drive Model 3401 offers a lightweight option that produces above-average performance.

▶FACT FILE

CD Porta-Drive Model T3401

CD Technology Inc., 766 San Aleso Ave., Sunnyvale, CA 94084; 408-752-8500; fax, 408-752-8501.

List price: *$1,050; includes external double-speed drive, caddy, Future Domain 850M SCSI interface card (8-bit ISA), cables, AC adapter, software. Bare drive with caddy and AC adapter, $850; Future Domain 850M, $200; Future Domain SCSI interface card (16-bit ISA), $300; SCSI interface card (Micro Channel), $300; Adaptec parallel-to-SCSI adapter, $250; 5 caddies, $60. Internal model: bare drive, $700.*

Circle 451 on reader service card

The CD-ROM Drive That Comes with the System

This table shows which CD-ROM drives are bundled with selected desktop systems sold by the top ten PC vendors. Vendor rankings were provided by CI InfoCorp and are based on the number of DOS-based desktop systems sold in the U.S. to end users in 1993.

Rank	PC vendor	Products	CD-ROM drive bundled with selected configurations	Speed
1	IBM Corp.	PS/1 line	Panasonic CR-563B*	Double
		PS/2 Ultimedia line	IBM CD-ROM II*	Double
		ValuePoint MVP Series	Panasonic CR-562*	Double
2	Compaq Computer Corp.	All Compaq lines	N/A	N/A
3	Packard Bell Electronics Inc.	All Packard Bell lines	Panasonic (model number not available)*	Single or double
4	Dell Corp.	All Dell lines	Panasonic CD-563B*	Double
5	Gateway 2000 Inc.	Pentium- and 486DX2/66-based systems	Mitsumi FX-001D*	Double
		Other selected systems	Sony CDU-31A	Single
6	AST Research Inc.	AST Advantage! line	Panasonic CR-562* and Sony CDU-33A	Double
		AST Bravo line	Sony CDU-31A	Single
		AST Premmia line	Toshiba 3401B	Double
7	Acer America Corp.	Acer Acros line	Panasonic CR-563B*	Double
		AcerAltos line	Sony CDU-541	Single
		AcerFormula line	Sony CDU-541	Single
		AcerPower line	Sony CDU-541	Single
8	NEC Technologies Inc.	Ready 425CD2 line	NEC (model number not available)*	Triple
		Ready 433CD3 line	NEC MultiSpin 3Xe	Triple
9	Epson America Inc.	Epson Endeavor line	NEC 55JD*	Double
10	Digital Equipment Corp.	All Digital lines	Sony CDU-31A	Single

* This drive is not available separately N/A—Not applicable. Compaq systems are configured to user specifications.

Chinon America Inc.

Chinon CDS-435
Chinon CDS-535

BY STEPHEN C.M. CHEN

Chinon America's double-speed Chinon CDS-535 drive, an Editors' Choice selection, offers outstanding performance and a respectable $745 list price (which includes a Chinon SCSI adapter for the ISA bus). This drive is a great choice for multimedia playback. On the other hand, the single-speed Chinon CDS-435 reader—$595 with SCSI adapter—seems overpriced for its capabilities. Street prices for these internal CD-ROM drives average about $370 and $290, respectively.

The double-speed CDS-535 was one of only three drives that completed our most demanding multimedia playback test without dropping a single frame of video. The drive placed second on our Text Search tests and third on our TIFF Image File Load test—which means it was faster than the triple-speed NEC MultiSpin 3Xe. And the Chinon unit came with a variety of CD titles, too. Only its Red Book audio quality (for playing audio CDs) was lacking: The CDS-535 turned in distortion scores that were significantly worse than any other drive tested, and it evidenced poor frequency response and channel separation.

The single-speed CDS-435 is a less compelling buy. The drive performed well (relative to other single-speed drives) on many of our tests; on the most complex of our multimedia tests, though, it experienced audio dropouts and jumpy video. The CDS-435 is also the only reviewed drive that does not support multisession Photo CDs (nor does it support the CD-ROM XA standard).

The CDS-435 and CDS-535.

Both Chinon drives are easy to install; we didn't have to change the default settings on the interface cards or software. And both offer plenty of features, including rear-mounted line-out jacks and a front-mounted headphone jack with volume control. The drives come not only with installation and driver software but also with a lens-cleaning disk and with audio-player software that mimics the functions of an audio-CD control panel. External versions of the drives are available for an additional $150.

Chinon's single-speed CDS-435 drive may be a hard purchase to justify—there are double-speed drives that offer better performance at lower prices. But the double-speed CDS-535 is an excellent choice if Red Book audio quality is not important to you.

▶FACT FILE

Chinon CDS-435

Chinon America Inc., 615 Hawaii Ave. Torrance, CA 90503; 800-441-0222, 310-533-0274; fax, 310-533-1727.

List price: *$595; includes internal single-speed drive, caddy, Chinon SCSI interface card (8-bit ISA), cables, software, audio player software, Mavis Beacon Teaches Typing MPC, Chessmaster 3000 MPC, Great Cities of the World MPC, U.S. Atlas MPC, World Atlas MPC, San Diego Zoo presents The Animals MPC, Sherlock Holmes MPC, Selectware, cleaning disk. Bare drive with caddy, $495; Chinon SCSI interface card and cable, $100. External model: Bare drive with caddy (Model*

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■ RAM expandable to 64MB on the motherboard.	**486SX-33 $1295** Lease $55/month	**486SX-33 $1595** Lease $58/month	**486SX-33 $2095** Lease $76/month	**486SX-33 $2495** Lease $90/month
■ Two serial ports and one parallel port integrated on the motherboard.	**486DX-33 $1395** Lease $59/month	**486DX-33 $1695** Lease $61/month	**486DX-33 $2195** Lease $79/month	**486DX-33 $2595** Lease $94/month
■ Flash BIOS for easy upgradability.	**486DX2-50 $1495** Lease $63/month	**486DX2-50 $1795** Lease $65/month	**486DX2-50 $2295** Lease $83/month	**486DX2-50 $2695** Lease $98/month
■ Eight expansion slots: two VESA local bus, five 16-bit and one 8-bit.	**486DX2-66 $1695** Lease $61/month	**486DX2-66 $1995** Lease $72/month	**486DX2-66 $2495** Lease $90/month	**486DX2-66 $2895** Lease $105/month
■ ZEOS six-bay desktop case with two cooling fans for increased reliability and product life.	■ **Intel Verified:** for the Pentium™ OverDrive™ Processor	■ **Intel Verified:** for the Pentium™ OverDrive™ Processor	■ **Intel Verified:** for the Pentium™ OverDrive™ Processor	■ **Intel Verified:** for the Pentium™ OverDrive™ Processor
■ 200 watt power supply with built-in surge suppression; switchable between 115/230V.	■ 2MB high-speed RAM	■ 4MB high-speed RAM	■ 8MB high-speed RAM	■ 16MB high-speed RAM
■ Socket for inexpensive optional on-board SCSI.	■ 107MB local bus IDE hard drive with 32K cache	■ 214MB local bus IDE hard drive with 128K cache	■ 426MB, 13ms local bus IDE hard drive with 128K cache	■ 528MB, 12ms local bus IDE hard drive with 256K cache
■ Shadow RAM support.	■ 3.5" 1.44MB floppy drive	■ 3.5" 1.44MB floppy drive	■ **2X CD-ROM drive,** 3.5" 1.44MB floppy	■ **2X CD-ROM drive,** 3.5" 1.44MB floppy
■ ZEOS 101-key space-saving keyboard.	■ Diamond SpeedStar Pro Windows-accelerated local bus video with 1MB RAM. (16.7 million colors)	■ Diamond SpeedStar Pro Windows-accelerated local bus video with 1MB RAM. (16.7 million colors)	■ Diamond SpeedStar Pro Windows-accelerated local bus video with 1MB RAM. (16.7 million colors)	■ Diamond SpeedStar Pro Windows-accelerated local bus video with 1MB RAM. (16.7 million colors)
■ FCC Certified Class B; UL Listed.	■ ZEOS 14" 1024 x 768 NI SVGA color monitor, .28mm dot pitch	■ ZEOS 14" 1024 x 768 NI SVGA color monitor, .28mm dot pitch	■ ZEOS 14" 1024 x 768 NI SVGA color monitor, .28mm dot pitch	■ ZEOS 14" 1024 x 768 NI SVGA color monitor, .28mm dot pitch
■ Complete ZEOS Customer Satisfaction Package.	■ Microsoft DOS 6.2 with Enhanced Tools	■ Microsoft DOS 6.2 with Tools, Windows for Workgroups 3.11 & Microsoft Mouse	■ Microsoft DOS 6.2 with Tools, Windows for Workgroups 3.11 & Microsoft Mouse	■ Microsoft DOS 6.2 with Tools, Windows for Workgroups 3.11 & Microsoft Mouse
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intel inside pentium processor

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486DX-33 **$2343**

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EDITORS' CHOICE

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Circle 452 on reader service card

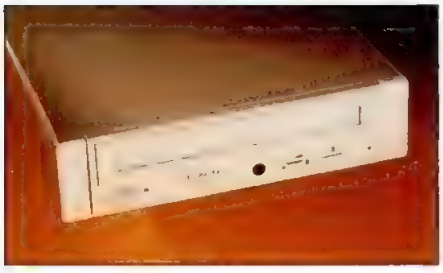
Hitachi Home Electronics (America) Inc., Multimedia Systems Division

Hitachi CDR-1900SPC

BY PATRICK HONAN

At $1,035 with a proprietary interface card, the Hitachi CDR-1900SPC from Hitachi Home Electronics (America), Multimedia Systems Division, is pricey if you're planning to use it for typical CD-ROM applications. And this internal unit's performance did not match that of many of the other double-speed drives we tested. For drives that support the CD-I (CD-Interactive) standard, though, this drive's street price—which falls between $700 and $800—is not out of line.

This drive turned in consistently below-average performance scores, taking nearly twice as long as the fastest drives to complete our Text Search tests. When playing back multimedia clips, the drive placed a higher-than-average load on the CPU; on the most difficult multimedia playback test,



The Hitachi CDR-1900SPC.

the CDR-1900SPC skipped more than 90 percent of the video frames.

The CDR-1900SPC does not support audio oversampling, and its Red Book audio quality (for playing audio CDs) was generally poor. Total harmonic distortion and intermodulation distortion were among the highest of the tested units.

On the plus side, the CDR-1900SPC was simple to set up and operate. Installation required only five minutes, using the default settings on the installation software and Hitachi's proprietary 8-bit ISA interface board. (Hitachi also offers a Micro Channel interface board for an additional $170.) Documentation was brief but adequately covered the essentials.

The CDR-1900SPC comes with a self-cleaning lens, double doors, and an airtight chassis. The drive lets you eject caddies manually (with a front-panel button), with a software command, or with an emergency eject button. CD-ROM XA, multisession Photo CD, and CD-I formats are supported. But with its lackluster performance and high price, the Hitachi CDR-1900SPC does not stand out from the pack.

▶FACT FILE

Hitachi CDR-1900SPC
Hitachi Home Electronics (America), Multimedia Systems Division, 3890 Steve Reynolds Blvd., Norcross, GA 30093; 800-241-6558, 404-279-5600; fax, 404-279-5696.
List price: *$1,035; includes internal drive, Hitachi proprietary interface board (8-bit ISA), cables, installation software. Bare drive, $855; Hitachi proprietary interface board (8-bit ISA), $70; Hitachi proprietary interface board (Micro Channel), $170.*
Circle 453 on reader service card

Legacy Storage Systems Inc.

Legacy CD-ROM 2x

BY GREG PASTRICK

Legacy Storage Systems specializes in backup and mass-storage systems for network file servers and high-end workstations. The company's double-speed Legacy CD-ROM 2x shipped to us with CorelSCSI drivers and an Adaptec AHA 1740/42A SCSI-2 adapter for the EISA bus. This $1,949 combination (about $1,500 on the street) turned in strong performance.

The CD-ROM 2x finished near the top of the pack on our Text Search tests and on our TIFF Image File Load test. The drive dropped only about a third of the video frames on our most taxing multimedia clip, offering better performance than many of the other double-speed models. Because the drive offers no line-out connectors, we tested Red Book audio quality (for playing audio CDs) over the headphone jack instead; while we observed good frequency response, other results

The Legacy CD-ROM 2x.

were only average.

Installing the Legacy drive is a two-step process. First you must configure the EISA bus to recognize the Adaptec host adapter card. Then you have to load the CorelSCSI drivers. The CD-ROM 2x has two standard SCSI-2 connectors at its rear, where the power plug and SCSI ID selector are also located. Legacy's 20 pages of documentation were not especially helpful, but installation was thoroughly documented in the component manufacturers' original manuals.

The CD-ROM 2x supports CD-ROM XA and Photo CD multisession formats. Legacy offers this drive with ISA and Micro Channel interface cards, and it will also ship the unit as a standard internal device, mounted on a device tray, or with rails for installation in secure network CD-ROM cabinets. These options and the bus-mastering Adaptec EISA controller make the drive a strong candidate for use on a network server.

▶FACT FILE

Legacy CD-ROM 2x
Legacy Storage Systems Inc., 25A South Street, Hopkinton, MA 01748; 800-966-6442, 508-435-4700; fax, 508-435-3080.
List price: *$1,949; includes external double-speed drive, Adaptec AHA 1740/42A SCSI-2 interface card (EISA), cables, CorelSCSI software. Bare drive, $999; Adaptec AHA 1740/42A interface card and cable, $850; Adaptec 1540/42 interface card (16-bit ISA) and cable, $495; Adaptec 1640 interface card (Micro Channel) and cable, $600.*
Circle 454 on reader service card

Liberty Systems Inc.

Liberty 115CDP

BY GREG PASTRICK

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The Liberty 115CDP.

and Macintoshes. The Liberty 115CDP is a 4.2-pound, external double-speed CD-ROM drive; with both SCSI-2 and direct parallel-port connectors built in, it's easily adaptable to both desktop and portable use. The drive, together with an 8-bit SCSI adapter from Rancho Technology, lists for $888 direct from Liberty.

The Liberty drive/SCSI adapter combination turned in strong performance scores, outperforming many of the other units based on the same Toshiba XM3401B mechanism. It performed well on our Text Search tests, ably handled complex multimedia clips, and produced average-quality Red Book audio output. The drive supports multisession Photo CDs and the CD-ROM XA format.

Most parallel-port interfaces are a mixed blessing: They provide near-universal compatibility at the expense of speed. But the 115CDP's dual-interface design minimizes tradeoffs. On SCSI-equipped machines, you can tap the drive's full performance potential; on other machines, you can use the drive for less-intensive applications. (Expect multimedia playback to be a problem over the parallel port.) A pass-through is provided so you can continue to use a printer even when the drive is connected via the parallel port.

If you don't need the parallel-port connectivity at all, you can shave $100 off the drive's list price. Given Liberty's extensive line of portable-centric options—including PCMCIA-to-SCSI adapters—you may be able to get by without it. While no battery pack is available to make the drive truly portable, the 115CDP is well suited to transportable use.

▶FACT FILE

Liberty 115CDP

Liberty Systems Inc., 160 Saratoga Ave., #38, Santa Clara, CA 95051; 408-983-1127; fax, 408-243-2885.

List price: *$888; includes external double-speed drive with parallel-port and SCSI connectors, Rancho Technology RT1000A-6 SCSI interface card (8-bit ISA), cables, integrated AC adapter, software. Bare drive, $799; bare drive without parallel port, $699; Rancho Technology RT1000A-6 interface card, $89; Trantor T130B SCSI interface card (8-bit ISA), $89; Future Domain TMC1670SVP SCSI interface card (16-bit ISA), $179.*

Circle 455 on reader service card

MacProducts USA Inc.

MacProducts Magic CD Pro

BY GREG PASTRICK

Just because the company name has "Mac" in it doesn't mean MacProducts USA is not a ready source of PC-compatible peripherals. The company primarily targets the Apple Macintosh market, but its MacProducts Magic CD Pro CD-ROM drive ($748 with a parallel-to-SCSI adapter) works with PCs also. If you buy the drive for easy portability, though, you'll pay the price in performance.

The MacProducts Magic CD Pro.

The Magic CD Pro is based on the Toshiba XM-3401 mechanism, itself a solid performer. But couple the drive with the Always Technology AL-1000 parallel-to-SCSI adapter—the interface that MacProducts USA says most Windows users request—and throughput drops dramatically. In this configuration, the Magic CD Pro placed almost last on most tests; it fared particularly poorly when playing back multimedia clips. On complex sequences, video and audio breaks were clearly evident. Even on small clips encoded in simple formats, CPU utilization was very high.

The Magic CD Pro did demonstrate above-average Red Book audio quality (for playing audio CDs)—with strong frequency response and low total harmonic distortion. And its installation was a simple task, thanks to the parallel-port connection and CorelSCSI driver software. The unit's side-mounted parallel pass-through means you don't have to give up your printer to use the drive. At 6.8 pounds, though, the Magic CD Pro is somewhat more luggable than it is portable—especially since it runs on AC only.

The Magic CD Pro includes everything you need, even drivers, to connect it to a Macintosh system. If your priority is finding a CD-ROM reader that can readily be swapped between systems—and even across platforms—then the MacProducts Magic CD Pro is a good bet.

▶FACT FILE

MacProducts Magic CD Pro

MacProducts USA, 608 W. 22nd St., Austin, TX 78705; 800-622-3475, 512-472-8881; fax, 512-499-0889.

List price: *$748; includes external double-speed drive, Always Technology AL-1000 parallel-to-SCSI adapter, AC adapter, CorelSCSI software. Bare drive with cables and software, $549; Always Technology AL-1000 Pro kit (includes CorelSCSI software and AL-1000 adapter), $199.*

Circle 456 on reader support card

Micro Design International Inc.

Micro Design SCSI Express 600CDX

BY GREG PASTRICK

Micro Design International takes a big-systems approach to mass-storage devices. All its desktop products are uniformly packaged with built-in rails for easy stacking. And all of them can work together under the company's sophisticated SCSI Express software, which is available for AIX, DOS, HP-UX, NetWare, OS/2, Solaris, System 7,

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In Canada: Arrow (800) 668-5543, Computer Brokers of Canada (800) 465-1616, Ingram Micro (800) 668-3450, Tech Data Canada (800) 668-5588.

How We Tested

We've dramatically expanded our CD-ROM performance test suite this year to test the drives in a variety of scenarios. In addition to measuring throughput, we timed real-world text searches, performed large-file loads, and quantified Microsoft Video for Windows-based multimedia playback.

Our test results showed that the best performers were the quadruple-speed Pioneer DRM-604X and the double-speed Chinon CDS-535 and PLI CD-ROM MS drives. The new triple-speed NEC MultiSpin 3Xe, though it turned in strong results on our Sequential Read test, was only average on our real-world tests. As we expected, drives that connect through parallel ports (rather than via SCSI or proprietary interface cards) were severely impaired during testing. And many double-speed drives were overwhelmed by complex multimedia clips.

TEST ENVIRONMENT

As our test platform, we used 486DX2/66-based, EISA/VL-Bus units from Micron Computer. Each system had 256K of L2 cache, 8MB of RAM, and a Diamond Viper VLB video adapter based on Weitek's P9000 accelerator chip. Tests were conducted at 800-by-600 resolution in 24-bit color. During multimedia testing, we used a Creative Labs Sound Blaster 16 ASP for generating audio output. Our CD-R disk was produced on a Pinnacle Micro RCD-202 recorder.

SEQUENTIAL AND RANDOM READS

Our new Microsoft Windows-based, low-level throughput tests measure the raw sequential and random data-transfer speeds of the CD-ROM subsystems. Applications read data off the disk by using different block sizes; 512-byte, 2K, 4K, 8K, and 16K blocks are common. Here we show results for 16K blocks, which represent the drives' optimal data-transfer rates. Both sequential- and random-read performance are depicted, although sequential reads predominate in most CD-based applications.

We found that most drives approached or met their claimed throughput ratings of 300 kilobytes per second (double-speed) and 150 KBps (single-speed); the notable exceptions were the parallel-port units. Even the double-speed parallel-port models topped out at 159 KBps. The Pioneer DRM-604X and NEC MultiSpin 3Xe lived up to their billings, and drives based on the popular Toshiba XM-3401 double-speed mechanism were also very strong performers.

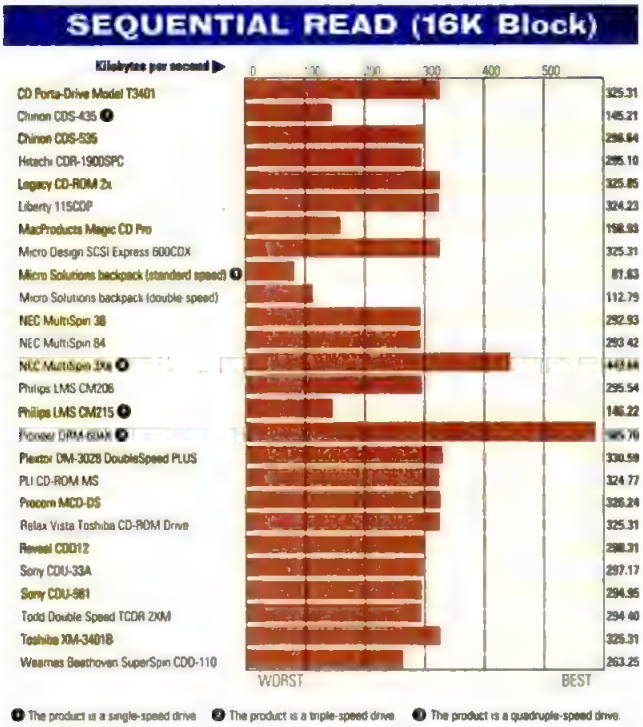
FILE LOAD AND TEXT SEARCH

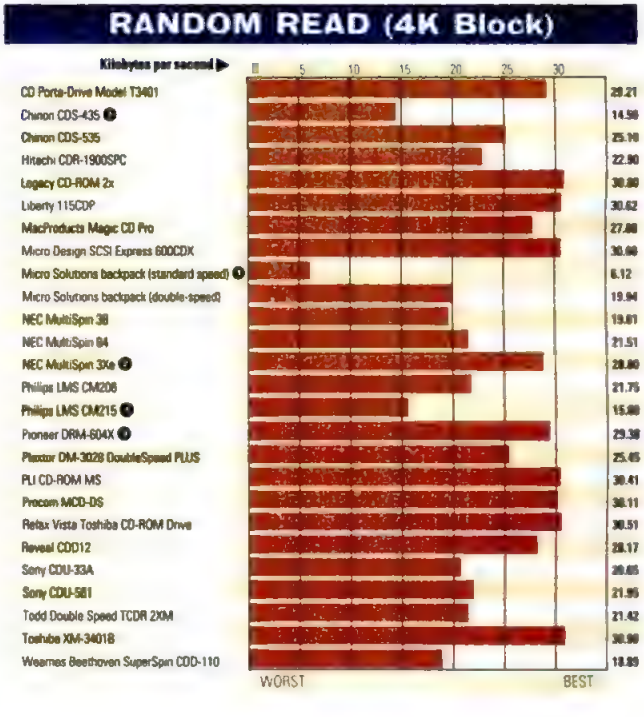
We tested each CD-ROM subsystem by loading a 32MB, 24-bit TIFF image from a recordable CD-R disk into Adobe Photoshop for Windows. This test was designed to determine whether faster drives would indeed perform better than single-speed models when heavy CPU, video, and disk overhead is involved. Three subsystems were unable to read the custom disk successfully; among the others, we found that the higher-speed drives did not show proportionately better performance, although the Pioneer DRM-604X was again the fastest performer.

To test performance in a text-search task, we used the DOS version of Ziff-Davis's Computer Select CD-ROM database, which contains thousands of full-text articles from hundreds of computer-industry periodicals. Searching Computer Select primarily involves sequential-read operations, as large word indices are scanned.

Our first search ("simple") was for the word *the*, which occurred in more than 2.3 million index entries and appeared in more than 75,000 articles. Our second search ("Boolean") combined multiple words separated by Boolean operators; specifically, we requested all articles containing *at* AND *is* OR *a*. This netted nearly 73,000 articles.

Most of the double-speed drives were twice as fast as the single-speed





❶ The product is a single-speed drive ❷ The product is a triple-speed drive ❹ The product is a quadruple-speed drive

drives at performing these two searches. The quadruple-speed Pioneer DRM-604X was fastest of all, though it didn't work at twice the speed of the double-speed units. We attribute this diminishing return to application overhead: The CPU and other subsystems became the bottleneck, not the CD-ROM drive. The Micro Solutions and MacProducts USA systems were the poorest performers because of their slow parallel interfaces.

MULTIMEDIA PLAYBACK

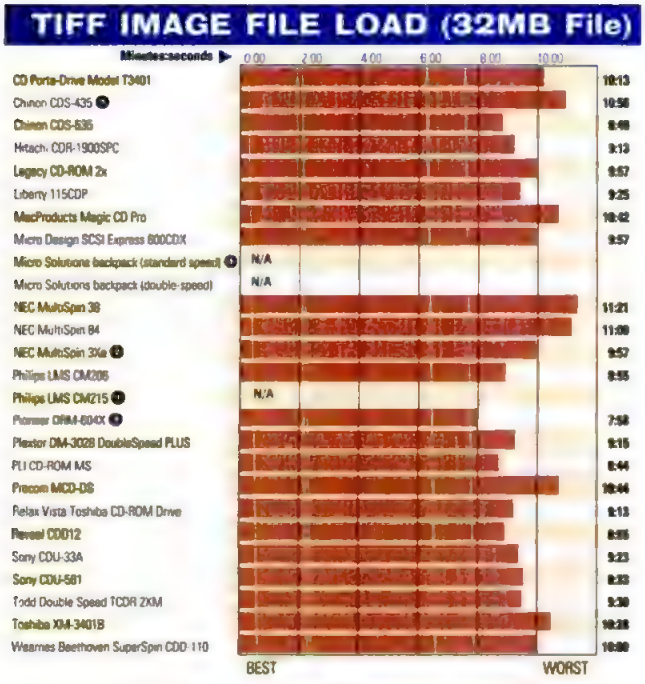
For gauging the quality of multimedia playback, Microsoft Corp. granted us permission to use VidTest, a Windows-based, digital-video performance-test program. VidTest, which has become a de facto industry standard for measuring performance on multimedia PCs, can measure the number of dropped video frames and audio segments during playback of AVI (audio video interleaved) files. Its Data Streaming test also measures CPU utilization attributable to the CD-ROM subsystem.

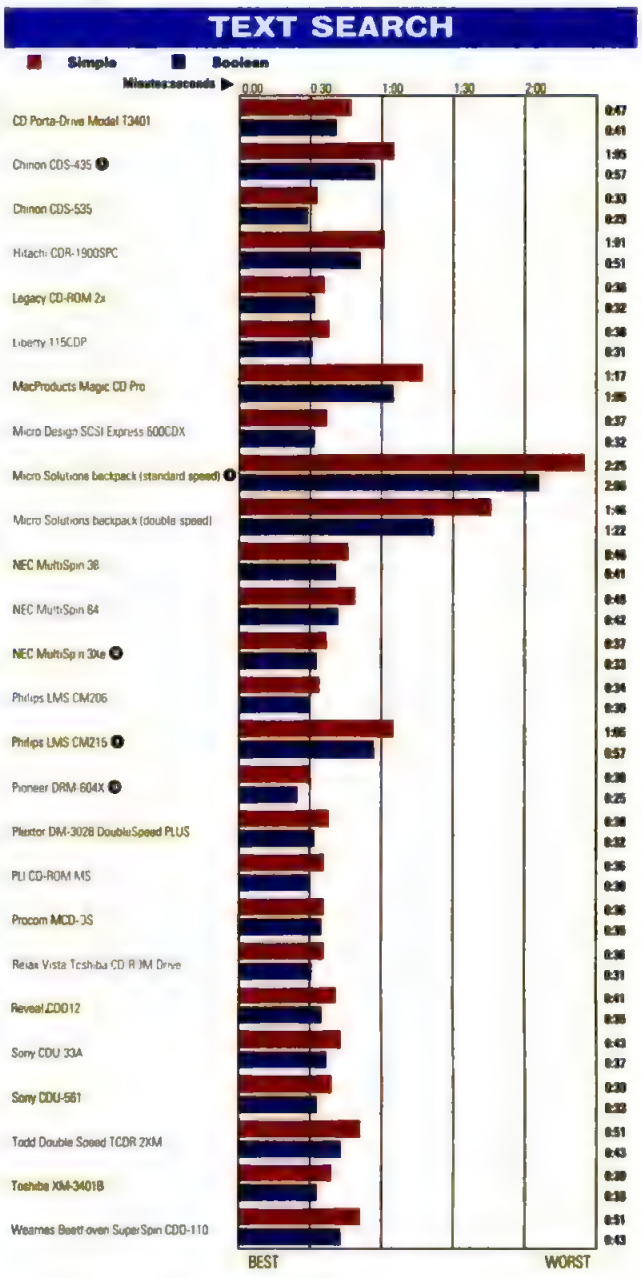
VidTest uses Microsoft Video for Windows drivers and is distributed on the Microsoft Multimedia Pack. Aris Multimedia Entertainment markets a similar test program, called the MPC Wizard. Neither VidTest nor Aris' Wizard were endorsed by the Multimedia PC Marketing Council (MPC) at the time of this writing. We used VidTest to play four different AVI files, compressed with either Microsoft's Video 1 compression scheme or Intel's Indeo compression technology.

The first three files contained 15-frame-per-second, 160-by-120 video at 8-, 16-, and 24-bit color depths. These 160-by-120 files are designed to play satisfactorily on 150-KBps, single-speed players. Our final AVI test file—a 320-by-240, 8-bit clip—was geared to run with 300-KBps double-speed drives.

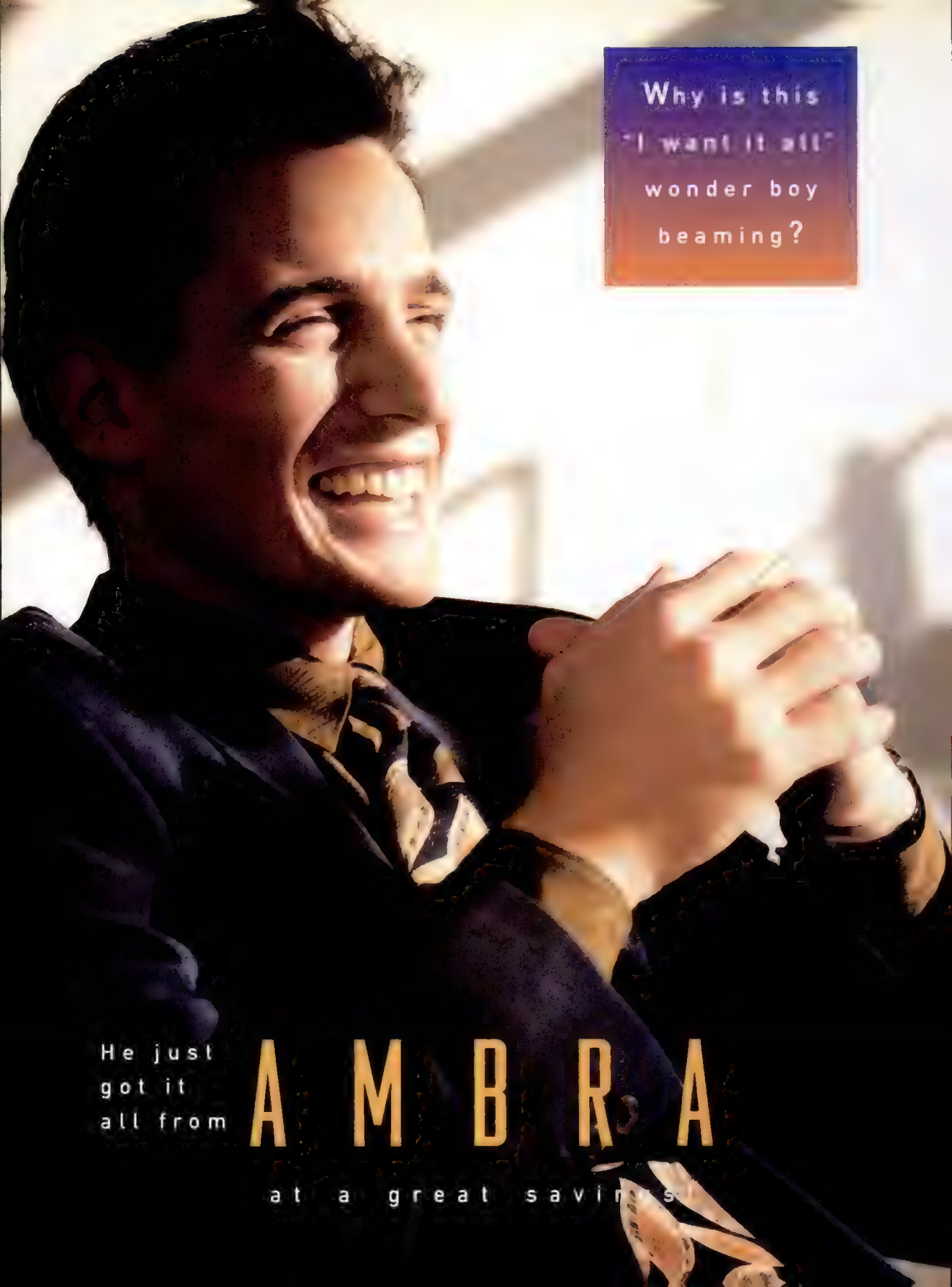
A few missed video frames are less discernible than a break in audio continuity, so we set audio playback to have a higher priority than video. Most of the drives dropped some video frames in the 320-by-240 clip. When audio/video synchronization problems surfaced at the 15-frame-per-second playback rate, video frames were dropped before audio. Micro Solutions' parallel-port products and MacProducts USA's SCSI-to-parallel subsystem suffered mild problems with dropped audio in addition to dropped video.

Some variation in CPU utilization among subsystems was evident, partly the result of differing driver and host-adapter combinations. The MPC states that a maximum of 40 percent CPU utilization is allowable for single-speed drives sustaining a 150-KBps transfer rate. It recommends no higher than 60 percent for double-speed drives at 300 Kbps. Because no standards exist for testing CPU utilization or transfer rates, we suggest looking for systems with the fewest dropped frames and the lowest CPU utilization for a particular file type.





❶ The product is a single-speed drive ❷ The product is a triple-speed drive ❹ The product is a quadruple-speed drive N/A—Not applicable The drive could not read the disk recorded on a CD-R device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- 128KB processor cache
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- 440MB hard disk
- 5 ISA slots
- 5 drive bays
- Windows accelerator, 1MB video memory
- 2X CD-ROM drive
- 15" Flat Square color monitor, LR, NI
- MS-DOS 6.0, Windows 3.1
- Mouse

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BIG VALUE!

D466DXA
- 486DX2, 66 MHz
- 8MB RAM
- 128KB processor cache
- 3.5" 1.44MB diskette drive
- 440MB hard disk
- 5 ISA slots
- 5 drive bays
- Windows accelerator, 1MB video memory
- 2X CD-ROM drive
- 17" Flat Square color monitor, LR, NI
- MS-DOS 6.0, Windows 3.1
- Mouse

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- Intel Pentium processor, 60 MHz
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- 8MB RAM
- 256KB processor cache
- 3.5" 1.44MB diskette drive
- 340MB hard disk
- 4 ISA, 2 PCI, 1 PCI/ISA slot
- 6 drive bays
- PCI graphics accelerator, 2MB DRAM
- 15" Flat Square color monitor, LR, NI
- MS-DOS 6.0, Windows 3.1
- Mouse

$2,889

DP60/PCI
- Intel Pentium processor, 60 MHz
- 64-bit data path
- 16MB RAM
- 256KB processor cache
- 3.5" 1.44MB diskette drive
- 440MB hard disk
- 4 ISA, 2 PCI, 1 PCI/ISA slot
- 6 drive bays
- PCI graphics accelerator, 2MB DRAM
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MULTIMEDIA PLAYBACK

	Video 1 Compression (8-bit, 930 frames, 160-by-120 resolution)			(16-bit, 930 frames, 160-by-120 resolution)			Intel Indeo Video Compression (24-bit, 930 frames, 160-by-120 resolution)			Custom AVI file (8-bit, 226 frames, 320-by-240 resolution)		
	Number of video frames skipped	Number of audio breaks	CPU utilization (percent)	Number of video frames skipped	Number of audio breaks	CPU utilization (percent)	Number of video frames skipped	Number of audio breaks	CPU utilization (percent)	Number of video frames skipped	Number of audio breaks	CPU utilization (percent)
CD Porta-Drive Model T3401	0	0	39	0	0	39	0	0	39	171	0	76
Chinon CDS-435 ❹	0	0	29	0	0	29	0	0	29	207	9	100
Chinon CDS-535	0	0	13	0	0	13	0	0	13	0	0	25
Hitachi CDR-1900SPC	0	0	45	0	0	45	0	0	45	200	0	87
Legacy CD-ROM 2x	0	0	20	0	0	20	0	0	31	40	0	39
Liberty 115CDP	0	0	23	0	0	23	0	0	23	47	0	44
MacProducts Magic CD Pro	513	0	90	779	0	90	734	0	90	209	9	100
Micro Design SCSI Express 600CDX	0	0	23	0	0	23	0	0	22	42	0	44
Micro Solutions backpack (standard speed) ❶	771	27	100	813	22	100	818	21	100	210	14	100
Micro Solutions backpack (double-speed)	777	17	100	813	19	100	837	19	100	210	14	100
NEC MultiSpin 38	0	0	36	0	0	36	0	0	36	171	0	76
NEC MultiSpin 84	0	0	38	0	0	38	0	0	38	164	0	73
NEC MultiSpin 38e ❸	0	0	18	0	0	18	0	0	18	21	0	37
Philips LMS CM206	0	0	30	0	0	28	0	0	27	9	0	24
Philips LMS CM215 ❹	0	0	29	0	0	29	0	0	29	207	9	100
Pioneer DRM-604X ❹	0	0	9	0	0	9	0	0	9	0	0	18
Plextor DM-3028 DoubleSpeed PLUS	0	0	22	0	0	22	0	0	22	49	0	44
PLI CD-ROM MS	0	0	16	0	0	16	0	0	16	0	0	32
Procom MCD-DS	0	0	26	0	0	27	0	0	27	48	0	45
Relax Vista Toshiba CD-ROM Drive	0	0	22	0	0	22	0	0	22	45	0	44
Reveal CDD12	0	0	26	0	0	26	0	0	26	116	0	51
Sony CDU-33A	0	0	34	0	0	34	0	0	34	103	0	52
Sony CDU-561	0	0	21	0	0	21	0	0	21	42	0	42
Todd Double Speed TCDR 200M	0	0	46	0	0	46	0	0	46	200	0	87
Toshiba XM-3401B	0	0	26	0	0	25	0	0	26	71	0	50
Wearnes Beethoven SuperSpin CDD-110	0	0	48	1	0	45	39	0	44	164	0	87

❶ The product is a single-speed drive ❷ The product is a triple-speed drive ❹ The product is a quadruple-speed drive

RED BOOK AUDIO QUALITY RESULTS

In terms of analog audio quality, we found no CD-ROM drive that could match our reference audio CD player, whose results are included in this table for comparison purposes. We have weighted the results of each test to produce an audio-quality rating for each drive. The three most significant factors in our evaluation were

- *Frequency response.* A full range of 20 Hz to 20 kHz is essential;
- *Signal-to-noise ratio.* Better drives score 90 decibels (dB) or higher;
- *Total harmonic distortion.* Lower numbers represent better performance and ratings above 0.1 percent are unacceptable.

Of the tested units, the Micro Solutions backpack (double-speed) had the best audio quality. Other units to consider if audio quality is particularly important include the Micro Design SCSI Express 600CDX, Pioneer DRM-604X, and Relax Vista Toshiba CD-ROM Drive.

Most of these CD-ROM drives offer rear-panel line-out jacks, which we used for testing whenever available. Some units provided no line-out jacks, so we tested them at their headphone jacks, which generally provide a lower-quality signal. We performed our tests using a CBS CD-1 test disk and an Audio Precision System One analyzer.

The **output level** indicates the voltage at a unit's output terminals when playing a maximum-level (16 bits on), 1-kHz tone. Typical audio CD players produce about 2,000 millivolts under these conditions, but most CD-ROM players generate a maximum signal that is less than 1,000 mV. Higher output levels maximize the potential signal-to-noise ratio, but a limit of 1,000 mV is desirable for CD-ROM drives that will be connected to soundboards, many of which will be overloaded by signals exceeding roughly 1,000 mV.

Total harmonic distortion (THD) indicates the percentage of spurious tones generated by the CD-ROM drive when playing a pure, maximum tone of 1kHz. These undesirable components include harmonics of the 1-kHz frequency, as well as noise. A typical audio CD player will have 0.002 percent THD; most of the scores range from 0.01 percent to 0.03 percent. High THD indicates a shift in the harmonic structure of the music and an inaccurate reproduction of the recorded sounds.

Unix, and Xenix platforms.

The double-speed Micro Design SCSI Express 600CDX is well suited for a network server or engineering workstation. Paired with an Adaptec AHA-1540C SCSI-2 controller (for a total price of $1,339), the 600CDX placed among the top five double-speed drives on all but our TIFF Image File Load test. Playing back our most demanding multimedia clip, it dropped some video frames but fared well on the whole. It also turned in superior Red Book audio results (for playing audio CDs), and placed second on tests of harmonic distortion and quantization noise.

Micro Design first sent us its standard SCSI Express host adapter, which caused an unresolvable BIOS conflict on our testbed machine, a Micron 486DX2/66 EISA/VL-Bus system. The SCSI Express was replaced with the Adaptec board. Installing the replacement adapter and required drivers was straightforward.

The drive's real strength surfaces when you buy into the company's line of mass-storage products: DATs, magneto-optical drives, and hard disks. All come in cases with built-in tracks and rails for stacking and securing them; this helps consolidate devices into a single unit and

Red Book Audio Quality Results

	Output level (mV)	Total harmonic distortion (percent)	Signal-to-noise ratio (dB)	Quantization noise (dB)	Frequency response at -2 decibels (Hz)	Oversampling	Intermodulation distortion (percent)	Channel separation (dB)	Rating
Reference audio CD player	2,131	0.003	102.7	-91.3	Less than 5–20,000	4X	0.004	93.7	Excellent
CD Porta-Drive Model T3401	893	0.022	82.0	-79.1	Less than 5–20,000	4X	0.058	78.1	Average
Chinon CDS-435	712	0.028	98.3	-79.5	5–20,000	2X	0.083	62.7	Good
Chinon CDS-535	814	1.12	89.3	-71.2	Less than 5–12,000	2X	4.490	44.3	Poor
Hitachi CDR-1900SPC	714	0.067	87.7	-74.8	8–19,300	1X	0.153	50.1	Below average
Legacy CD-ROM 2x*	841	0.018	97.5	-94.1	5–20,000	4X	0.057	98.0	Good
Liberty 115CDP**	832	0.014	83.3	-79.9	Less than 5–20,000	4X	0.074	73.2	Good
MacProducts Magic CD Pro	866	0.016	96.9	-82.5	Less than 5–20,000	4X	0.069	84.8	Good
Micro Design SCSI Express 600CDX*	913	0.01	88.6	-85.3	5–20,000	4X	0.043	58.7	Good
Micro Solutions backpack (standard speed)	618	0.009	98.9	-98.3	5.5–20,000	4X	0.023	78.8	Very good
Micro Solutions backpack (double speed)	838	0.022	84.1	-80.7	Less than 5–20,000	4X	0.054	73.8	Average
NEC MultiSpin 38*	1,010	0.122	84.2	-73.7	5–12,000	2X	0.484	45.5	Poor
NEC MultiSpin 84	598	0.019	85.0	-81.1	Less than 5–14,000	2X	0.023	66.2	Below average
NEC MultiSpin 3Xe	606	0.019	86.8	-80.7	6–14,000	2X	0.015	62.1	Below average
Philips LMS CM206	1,217	0.169	90.5	-75.1	Less than 5–17,000	1X	0.956	74.7	Below average
Philips LMS CM215	1,244	0.169	86.5	-79.8	Less than 5–17,000	1X	0.973	84.0	Below average
Pioneer DRM-604X	1,822	0.029	103.6	-82.8	5–20,000	1X	0.112	81.0	Good
Plextor DM-3028 DoubleSpeed PLUS	2,140	0.053	90.1	-81.8	30–20,000	2X	0.180	72.1	Average
PLI CD-ROM MS	926	0.019	86.8	-82.3	Less than 5–20,000	4X	0.062	88.6	Good
Procam MCD-DS	871	0.019	85.7	-82.8	5–20,000	4X	0.056	73.7	Good
Relax Vista Toshiba CD-ROM Drive	900	0.018	84.1	-80.9	5–20,000	4X	0.051	72.5	Good
Reveal CDD12	843	0.017	96.1	-79.2	7.4–20,000	8X	0.002	N/A	Good
Sony CDU-33A	753	0.013	87.5	-81.5	5.5–20,000	1X	0.049	71.1	Good
Sony CDU-561	700	0.011	92.9	-75.1	9–20,000	1X	0.021	61.8	Good
Todd Double Speed TCDR 20M	720	0.028	81.1	-77.7	8–19,400	1X	0.068	51.4	Average
Toshiba XM-3401B*	931	0.012	85.7	-84.9	5–20,000	4X	0.038	80.2	Good
Wearnes Beethoven SuperSpin CDD-110*	1,043	0.082	86.4	-85.0	10–20,000	2X	0.117	N/A	Poor

* Because the drive has no line-out jacks, we used its headphone jack for testing. ** One channel in the drive was defective. We took readings from the functioning channel.
N/A—Not applicable. Because we were unable to obtain a stable signal, we could not measure this parameter.

The **signal-to-noise ratio** is the difference between a maximum-level signal and the inherent electronic noise (hiss and hum) introduced by the CD-ROM drive. An increase of 6 dB is equivalent to a doubling in intensity. The measurement is *A-weighted* to reflect the ear's greater sensitivity to hiss (high frequencies) than hum (low frequencies). In a good CD-ROM drive, the signal-to-noise ratio is typically greater than 100 dB.

Quantization noise is a reading specific to digital audio subsystems. The standard signal-to-noise ratio is measured under a no-signal condition, meaning that the digital-to-analog converter (DAC) in the CD-ROM drive remains idle. The quantization noise test measures noise while exercising the DAC. A lower result indicates less noise. Ideally, the quantization noise score would be -98 dB. Most of the tested drives scored between -70 dB and -80 dB.

Frequency response shows the range over which the CD-ROM drive accurately reproduces the relative amplitudes of audio signals. A drive should be able to reproduce all musically significant signals—frequencies between 20 Hz and 20,000 Hz—within a tolerance of 0.2 dB. In terms of quality, none of the tested CD-ROM drives approached audio players, so we have reported results at a more lenient 2-dB tolerance. A narrow frequency response is highly undesirable because it indicates an inability to reproduce a wide range of sounds accurately.

Oversampling indicates the number of times each digital signal is sampled. Sampling the digital signal at two, four, or eight times the usual 44.1-kHz rate improves audio reproduction by maintaining a flat frequency response and the proper signal phase, which is important in stereo imaging. Early audio CD players used 1X sampling, but contemporary audio CD players oversample.

Intermodulation distortion (IMD) is a measure of distortions that are unrelated to the natural harmonic structure of music and are therefore disturbing to the ear. IMD is measured while the unit simultaneously plays a 60-Hz tone and a 7,000-Hz tone, mixed in a standard 4-to-1 ratio. A reading of 0.002 percent is typical for a good CD player. Most of the tested units scored between 0.04 percent and 0.08 percent.

Channel separation measures signal leakage from one channel to the other. Imperfect channel separation reduces the accuracy of stereo imaging; zero separation represents a completely monophonic signal. A high-quality CD player will show 90 dB or greater channel separation.

obviates additional mounting hardware or cabinets. The firm's SCSI Express driver software provides jukebox support and can span multiple cartridges as a single logical volume.

▶FACT FILE

Micro Design SCSI Express 600CDX

Micro Design International, 6935 University Blvd., Winter Park, FL 32792; 407-677-8333; fax, 407-677-8365.

List price: *$1,339; includes external double-speed drive, 16-bit Adaptec AHA-1540C SCSI-2 adapter, SCSI Express for DOS software. Bare drive and caddy, $795; SCSI Express host adapter, $495; Adaptec AHA-1540C 16-bit controller, $249; SCSI Express for DOS software, $295; SCSI Express for Novell NetWare 386, $795. Internal version: Bare drive, $645.*

Circle 457 on reader support card

Micro Solutions Inc.

Micro Solutions backpack (standard and double-speed)

BY GREG PASTRICK

The Micro Solutions backpack CD-ROM drives, available in both $449 single-speed

and $499 double-speed versions, avoid the usual hassles of SCSI configuration and its potential for BIOS, interrupt, and I/O address conflicts. As with all of the company's peripheral mass-storage devices, the backpack drives connect via the parallel port. This arrangement makes it easy to transport the units among systems, but it severely limits their performance and renders them unsuitable for multimedia use.

Pushing data across the parallel port is a slow, CPU-intensive operation—a fact that was painfully apparent in our testing. While playing back even the simplest AVI (Audio-Video Interleaved) clips, both drives generated severe audio and video dropouts. On Sequential Read and Text Search tests, these drives placed last in their respective classes.

The Micro Solutions backpack.

The backpack drives were also unable to read the custom CD we used on our TIFF Image File Load test (created on a Pinnacle Micro RCD-202 CD recorder).

Performance aside, these Micro Solutions drives do have some appealing features. For one, you don't have to use a CD caddy with the drives; instead, disks load through a motorized tray that opens to the front. Their small footprints and light weights (5 pounds including an AC adapter) are welcome too.

▶FACT FILE

Micro Solutions backpack (standard speed)

Micro Solutions Inc., 132 W. Lincoln Hwy., DeKalb, IL 60115; 800-890-7227, 815-756-3411; fax, 815-756-2928.

List price: *$449; includes external single-speed drive, parallel cable, AC adapter, driver software. 3-foot parallel extension cable, $16.*

Micro Solutions backpack (double-speed)

List price: *$499; includes external double-speed drive, cables, AC adapter, drive software. 3-foot parallel extension cable, $16.*

Circle 458 on reader service card

NEC Technologies Inc.

NEC MultiSpin 38
NEC MultiSpin 84
NEC MultiSpin 3Xe

BY JOHN R. QUAIN

Although NEC Technologies was the first to introduce a double-speed CD-ROM drive, the company's two reviewed double-speed models are no longer the performance leaders. They have been edged out by slightly faster (and more expensive) models from other companies—and by NEC's own NEC MultiSpin 3Xe, the industry's first triple-speed CD-ROM drive.

NEC no longer quotes list prices for its drives, but it estimates a selling price of $360 for the NEC MultiSpin 38 portable unit, making it one of the lowest-priced models in this roundup. The internal NEC MultiSpin 84 has an estimated selling price of $565. (These prices include an 8-bit ISA SCSI adapter.) The MultiSpin 3Xe's estimated selling price is $725, which includes a 16-bit SCSI card.

We think triple-speed drives are a promising technology, but the early production unit that NEC sent us for testing didn't quite live up to our expectations. Though the external MultiSpin 3Xe turned in an impressive 445-kilobyte-per-second score on our Sequential Read test, the benefits of its triple-speed operation were less apparent on our applications-based tests. The triple-speed unit's Text Search and TIFF Image File Load scores were better than those of some—but by no means all—double-speed drives reviewed.

We believe the drive performed below its potential on these tests because it was required to read relatively small blocks, which additional testing showed to be a weak point for the drive. The MultiSpin 3Xe handled multimedia clips well, showing low CPU utilization, although it dropped a few frames on our demanding 320-by-240-pixel multimedia clip.

The MultiSpin 3Xe's Red Book audio quality (for playing audio CDs) was disappointing; frequency response dropped dramatically above 14 kHz. The drive is also available as an internal model (estimated selling price, $625 with adapter) and as a portable model ($570).

We tested NEC's two double-speed drives, the MultiSpin 38 and MultiSpin 84, with their Trantor T-130 8-bit SCSI cards; their performance was average to below average. While replaying the most demanding multimedia clip, both drives dropped over half of the video frames.

The double-speed NEC drives evidenced poor Red Book audio quality, with extremely limited frequency response. Both drives include a headphone jack with volume control and come with earphones; the portable MultiSpin 38 does not come with line-out jacks.

The MultiSpin 38's optional battery pack ($65) makes it the only truly portable drive we tested. With the battery pack, the unit's total weight is just over 3 pounds. A parallel-to-SCSI adapter with EPP (enhanced parallel port) support is a $169 option.

NEC also manufactures an external double-speed drive, the NEC MultiSpin 74, which is identical to the internal MultiSpin 84 and has an estimated selling price of $526, including a SCSI card.

All of NEC's CD-ROM drives support multisession Photo CD and CD-ROM XA disks. Setting up these units was straightforward: An automated DOS software installation routine copied the appropriate files and inserted necessary command-line entries.

NEC's MultiSpin CD-ROM drives.

▶FACT FILE

NEC MultiSpin 38

NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191-1094; 800-388-8888, 708-860-9500; fax, 800-366-0476.

Estimated selling price: *$360; includes ex-*

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SUMMARY OF FEATURES

CD-ROM Drives

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	CD Porta-Drive Model T3401	Chinon CDS-435	Chinon CDS-535	Hitachi CDR-1900SPC	Legacy CD-ROM 2x	Liberty 115CDP	MacProducts Magic CD Pro
List price (tested configuration)	$1,050	$595	$745	$1,035	$1,949	$888	$748
Physical Characteristics							
Mechanism model	Toshiba XM-3401B	Chinon 435	Chinon 535	Hitachi CDR-6700	Toshiba XM-3401B	Toshiba XM-3401B	Toshiba XM-3401 TA
Internal/external version available	■■	■■	■■	■■	■■	□■	□■
Version tested	External	Internal	Internal	External	External	External	External
External version:							
Case dimensions (HWD, in inches)	2.8 x 8.8 x 9.4	2.2 x 6 x 9.8	2.2 x 6 x 9.8	1.9 x 7.1 x 13.5	2.2 x 5.8 x 13.3	1.8 x 6.9 x 9.5	2.3 x 9.8 x 10.9
Weight (pounds)	3.4	5.5	5.5	7.7	5.7	4.2	6.8
Length of supplied interface cable (feet)	3	3	3	2.5	6	2.8	2.8
Voltage switching between 110V and 220V	Automatic	N/A❶	N/A❶	Manual	Manual	Manual	Automatic
Caddy manufacturer	CD Technology	Sony	Sony	Hitachi	Sony	Sony	Sony
Standards Supported							
CD-ROM XA	■	□	■	■	■	■	■
Single-session/multisession Photo CD	■■	■□	■■	■■	■■	■■	■■
CD—Interactive	□	□	□	■	□	□	□
Operating Features							
Power/busy indicator	□■	■■	■■	■■	□■	■■	□■
Autoload/Manual load	■□	■□	□■	■□	■■	■■	■■
Manual/software-controlled eject	■■	■■	■■	■■	■■	■■	■■
Audio support:							
Headphone jack	■	■	■	■	■	■	■
RCA jacks	■	■ (optional)	■ (optional)	■	□	■	■
Volume knob	■	■	■	■	■	■	■
Red Book audio–compatible	■	■	■	■	■	■	■
Performance Ratings							
Buffer size	256K	64K	256K	128K	256K	256K	256K
Average access time (milliseconds)	200	350	250	260	200	200	200
Data transfer rate (kilobytes per second)	330	150	300	307.2	330	330	330
Mean time between failures (hours)	50,000	25,000	50,000	30,000	50,000	50,000	30,000
Controller Characteristics							
Controller manufacturer	Future Domain	Chinon	NCS	Hitachi	Adaptec	Trantor	Always Technology
Tested interface	SCSI-2	SCSI	SCSI	Proprietary	SCSI-2	Parallel/SCSI	Parallel/SCSI
Interface card:							
Type	8-bit ISA	8-bit ISA	8-bit ISA	8-bit ISA	32-bit EISA	8-bit ISA	N/A❶
IRQs supported	3, 5	N/A❷	N/A❷	N/A❷	9, 10, 11, 12, 14, 15	3, 4, 5, 7	N/A❶
Number of selectable addresses	4	16	16	8	8	8	N/A❶
Maximum number of units in daisy chain	7	7	7	8	7	7	7
Alternative interfaces:							
MCA	■	□	□	■	■	■	■
Macintosh	■	□	□	□	■	■	■
Software Support							
Device driver supplier	Future Domain	Chinon	Chinon	Hitachi	Corel	Rancho	Corel
Version tested	2.3	5.5	1.1	3.05	1.2	1.0	1.03
Offers OS/2 driver support	□	□	□	■	■	■	□
Version of MS-DOS CD-ROM Extensions included	2.3	2.2	2.2	2.22	1.01D	2.21	2.21
Customer Support							
Toll-free technical support	□	■	■	■	■	□	■
Telephone support hours (eastern time)	11:00–8:00 M–F	11:30–8:00 M–F	11:30–8:00 M–F	9:00–5:00 M–F	8:30–6:30 M–Th, 8:30–5:00 F	11:00–8:00 M–F	9:00–6:00 M–F
24-hour BBS	□	□	■	□	□	□	■
Warranty coverage	1 year	1 year	1 year	2 years	1 year	1 year	1 year

N/A ❶—Not applicable: The product does not have this feature. N/A ❷—Not applicable: The product does not require an IRQ.

ternal double-speed drive, Trantor T-130 interface card (8-bit ISA), cables, AC adapter, software. Bare drive with AC adapter, $426; Trantor T-130 8-bit interface card, $80; Nickel cadmium battery, $65. Parallel-to-SCSI adapter with EPP support, $169; parallel-to-SCSI adapter, $95.

NEC MultiSpin 84

Estimated selling price: *$565; includes internal double-speed drive, Trantor T-130 interface card (8-bit ISA), cables, software. Bare drive, $485; Trantor T-130 interface card, $80. External model (MultiSpin 74): Bare drive with AC adapter, $426.*

NEC MultiSpin 3Xe

Estimated selling price: *$725; includes external triple-speed drive, Adaptec 160-NEC interface card (16-bit ISA), cables, software. Bare drive, $600; Adaptec 160-NEC interface card, $125. PS/2 interface kit (includes Adaptec 260-NEC 16-bit SCSI card, software, cables), $130. Internal model (MultiSpin 3Xi): Bare drive, $500. Portable model (MultiSpin 3Xp): Bare drive with AC adapter, $445.*

Circle 459 on reader service card

Philips LMS

Philips LMS CM206
Philips LMS CM215

BY JOSEPH DESPOSITO

Though attractively priced at $499 and $579 respectively, the Philips LMS CM206 and Philips LMS CM215 CD-ROM drives require compromises you may not be willing to make: The CM206 is

CONTINUES

	Micro Design SCSI Express 600CDX	Micro Solutions backpack (standard speed)	Micro Solutions backpack (double-speed)	NEC MultiSpin 38	NEC MultiSpin 84	NEC MultiSpin 3Xe
	$1,339	$449	$499	$360 (estimated)	$565 (estimated)	$725 (estimated)
	Toshiba XM-3401 TA	Mitsumi CMRC-FX001	Mitsumi CMRC-FX001D	NEC 38	NEC 84	NEC 3Xe
	■■	□■	□■	□■	■■	■■
	External	External	External	External	Internal	External
	3.7 x 7.8 x 14.8	2.3 x 6 x 10.5	2.3 x 6 x 10.5	1.9 x 5.5 x 9	3.1 x 9.1 x 9.9	3 x 6.9 x 13
	9.7	4.1	4.1	2.2	7.7	6.4
	3.2	3.2	3.2	3.2	3.2	3
	Automatic	N/A●	N/A●	N/A●	Manual	Manual
	Sony	N/A●	N/A●	N/A●	Daiichi Kasei	Daiichi Kasei
	■	■	■	■	■	■
	■■	■■	■■	■■	■■	■■
	□	□	□	□	□	□
	■■	□■	□■	■■	■■	■■
	■■	■□	■□	□■	□■	□■
	■■	■■	■■	■□	■■	■■
	■	■	■	■	■	■
	■	■	■	□	■	■
	■	■	■	■	■	■
	■	■	■	■	■	■
	256K	128K	32K	256K	256K	256K
	200	280	250	280	280	195
	330	150	300	300	300	450
	50,000	25,000	25,000	20,000	50,000	50,000
	Adaptec SCSI-2	N/A● Parallel	N/A● Parallel	Trantor SCSI	Trantor SCSI	Trantor SCSI-2
	16-bit ISA	N/A●	N/A●	8-bit ISA	8-bit ISA	16-bit ISA
	9, 10, 11, 12, 14, 15	N/A●	N/A●	3, 5, 7	3, 5, 7	3, 5, 7
	6	N/A●	N/A●	4	4	4
	7	None	None	8	8	8
	■	□	□	■	■	■
	■	□	□	■	■	■
	Adaptec	Micro Solutions	Micro Solutions	NEC	NEC	NEC
	1.0	1.03	1.05	3.01	3.01	3.01
	■	□	□	■	■	■
	2.21	2.2	2.2	2.0	2.0	2.2
	□	□	□	■	■	■
	8:00–8:00 M–F	9:00–6:00 M–F	9:00–6:00 M–F	8:30–7:00 M–F	8:30–7:00 M–F	8:30–7:00 M–F
	■	■	■	■	■	■
	1 year	1 year	1 year	2 years	2 years	2 years

a double-speed drive, but it comes with a proprietary Philips 16-bit interface card; The CM215 is a SCSI drive, but it is single speed. Though their list prices are different, both models sell on the street for about $299, including interface cards.

The double-speed CM206 turned in very good performance on our Sequential Read, Text Search, and multimedia playback tests, dropping only nine video frames out of 226 while playing our taxing custom AVI (Audio-Video Interleaved) file. The CM215's performance was typical for a single-speed drive: fair on our Text Search tests and poor on playback of our custom AVI file. The CM215 performed much better, however, on our other video playback tests. The CM215 was also one of only three drives that failed to read a disk created by a CD-Recordable drive. A company spokesperson said that this problem had already been identified and corrected. When it came to Red Book audio performance (for playing audio CDs), both drives were poor performers, with unnacceptably high total harmonic and intermodulation distortion and poor frequency response.

The CM206 and CM215 are internal drives with motorized trays that let you load disks without a caddy. Both let you play audio CDs by simply pressing the volume-control knob. Other common features are support for CD-ROM XA and Photo CD single-session and multisession formats. Neither drive caused any setup problems.

Both the CM206 and CM215 offer average performance in their class at an attractive price. If you don't mind a proprietary interface, and if Red Book audio quality is not important to you, the CM206 is worth a look. If you can't live without a SCSI interface but don't mind the restrictions of a single-speed drive, the CM215 is reasonably priced.

The Philips LMS CM206.

▶FACT FILE

Philips LMS CM206

Philips LMS, 4425 ArrowsWest Dr., Colorado Springs, CO 80907; 800-777-LMSI, 719-593-7900; fax, 719-531-0168.

List price: *$499; includes internal double-speed CD ROM drive, proprietary 16-bit interface kit, cable, drivers, setup software.*

Philips LMS CM215

List price: *$579; includes internal single-speed CD ROM drive, Future Domain 8-bit SCSI-2 interface kit, cable, drivers, setup software.*

Circle 460 on reader service card

Pioneer New Media Technologies Inc., Laser Optical Systems Group

Pioneer DRM-604X

BY HOWARD ALEXANDER

Not only was the Pioneer DRM-604X (list price $2,045, street price between $1,200 and 1,300) the first quadruple-speed drive on the market, but it can also lay claim to being the first personal CD-ROM chang-

SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

PC MAGAZINE PC MAGAZINE

	Philips LMS CM206	Philips LMS CM215	Pioneer DRM-604X	Plextor DM-3028 Double-Speed PLUS	PLI CD-ROM MS	Procom MCD-DS	Relax Vista Toshiba CD-ROM Drive
List price (tested configuration)	$499	$579	$2,045	$399	$918	$1,024	$678
Physical Characteristics							
Mechanism model	Philips LMS CM206	Philips LMS CM215	Pioneer DRM-604	Plextor DM-3028	Toshiba XM-3401B	Toshiba XM-3401B	Toshiba XM-3401E
Internal/external version available	■□	■□	□■	■■	■■	□■	□■
Version tested	Internal	Internal	External	Internal	External	External	External
External version:							
Case dimensions (HWD, in inches)	N/A●	N/A●	4 x 8.2 x 14.6	2.2 x 9.8 x 10.4	2.8 x 9.8 x 9.4	2.8 x 9.6 x 10.7	2.7 x 8.7 x 9.8
Weight (pounds)	N/A●	N/A●	9.0	7.1	6.2	5.8	4.3
Length of supplied interface cable (feet)	N/A●	N/A●	3.3	6	1.8	6.5	2.5
Voltage switching between 110V and 220V	N/A●	N/A●	Automatic	N/A●	Manual	Manual	Manual
Caddy manufacturer	N/A●	N/A●	Pioneer	Sony	Sony	Toshiba	Toshiba
Standards Supported							
CD-ROM XA	■	■	■	■	■	■	■
Single-session/multisession Photo CD	■■	■■	■■	■■	■■	■■	■■
CD-I–interactive	□	□	■	■	■	■	■
Operating Features							
Power/busy indicator	□■	□■	■■	■■	■■	□■	■■
Autoload/Manual load	■□	■□	□■	□■	□■	■■	■□
Manual/software-controlled eject	■■	■■	■■	■■	■■	■■	■■
Audio support:							
Headphone jack	■	■	■	■	■	■	■
RCA jacks	■ (on interface card)	■	■	□	■	■	■
Volume knob	■	■	■	■	■	■	■
Red Book audio–compatible	■	■	■	■	■	■	■
Performance Ratings							
Buffer size	64K	64K	128K	64K	256K	256K	256K
Average access time (milliseconds)	325	380	300	240	200	200	200
Data transfer rate (kilobytes per second)	307.2	153.6	614	335	330	330	330
Mean time between failures (hours)	20,000	20,000	20,000	50,000	50,000	50,000	50,000
Controller Characteristics							
Controller manufacturer	Philips LMS	Future Domain	Future Domain	Trantor	Future Domain	Procom Technology	Trantor
Tested interface	Proprietary	SCSI-2	SCSI-2	SCSI-2	SCSI-2	SCSI-2	SCSI-2
Interface card:							
Type	16-bit ISA	8-bit ISA	16-bit ISA	8-bit ISA	16-bit ISA	16-bit ISA	8-bit ISA
IRQs supported	3, 4, 5, 8, 7, 9, 10, 11, 12, 14, 15	3, 5	3, 5, 10, 11, 12, 14, 15	3, 5, 7	3, 5, 7, 10, 11, 12, 15	5, 9, 10, 11, 12, 14, 15	N/A●
Number of selectable addresses	8	6	4	4	4	6	8
Maximum number of units in daisy chain	None	7	7	7	7	7	8
Alternative interfaces:							
Macintosh	□	■	■	■	■	□	■
MCA	□	■	■	■	■	■	■
Software Support							
Device driver supplier	Philips LMS	Future Domain	Future Domain	Trantor	Future Domain	Procom Technology	Trantor
Version tested	1.0	2.31	3.2	1.1	3.03	2.03	3.02
Offers OS/2 driver support	□	□	■	■	■	□	■
Version of MS-DOS CD-ROM Extensions included	2.21	2.21	2.21	2.22	2.21	2.2	2.2
Customer Support							
Toll-free technical support	□	□	□	■	■	■	□
Telephone support hours (eastern time)	10:00–7:00 M–F	10:00–7:00 M–F	8:00–5:00 M–F	11:30–8:30 M–F	11:00–8:00 M–F	11:00–8:00 M–F	11:00–8:00 M–F
24-hour BBS	■	■	□	■	■	■	□
Warranty coverage	2 years	2 years	1 year	1 year	1 year	1 year	2 years

N/A ● –Not applicable: The product does not have this feature. N/A ● –Not applicable: The product does not require an IRQ.

er, taking a single cartridge that holds up to six CDs. Each disk in the changer is given a drive letter, so you have to keep track of which drive you assign each of your applications. The DRM-604X package does not provide any means of detecting which application is associated with each drive letter, though some multidisk applications provide that capability.

The quadruple-speed unit offers superior performance, with the highest Sequential Read, Text Search, and TIFF Image File Load test scores of any drive we tested.

The Pioneer DRM-604X.

The drive's Random Read score was slightly above average. Video playback was flawless and Red Book audio quality (for playing audio CDs) was above average, though intermodulation distortion was high. The disk change mechanism could be faster—it took 13 seconds to change and log-on to any disk in the six-disk cartridge—but it works very smoothly.

Installation of the DRM-604X was straightforward. The manuals are thorough and comprehensive, and the installation software is very simple to run. A numerical

ENDS

	Reveal CDD12	Sony CDU-33A	Sony CDU-561	Todd Double Speed TCDR 2XM	Toshiba XM-3401B	Wearnes Beethoven Super-Spin CDD-110
	$399	$270	$580	$1,009	$845	$399
	Matsushita CR-563-B	Sony CDU-33A	Sony CDU-561	Hitachi CDR-6700	Toshiba XM-3401B	Wearnes CDD-110
	■□	■□	■■	■■	■■	■■
	Internal	Internal	Internal	External	Internal	Internal
	N/A●	N/A●	2.3 x 7 x 12.6	2.1 x 6 x 13.8	2.7 x 8.7 x 9.8	2.5 x 6.5 x 10.5
	N/A●	N/A●	6	8.1	4.3	4.2
	N/A●	N/A●	3	3	3.3	2.8
	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●
	N/A●	N/A●	Sony	Sony	Sony	N/A●
	■	□	□	■	■	■
	■■	■■	■■	■■	■■	■■
	□	□	□	□	□	■
	□■	■■	■■	■■	■■	■■
	■□	■■	□■	■□	■□	■■
	■■	■■	■■	■■	■■	■■
	■	■	■	■	■	■
	■ (on interface card)	□	□	□	■	■
	■	■	■	■	■	■
	■	■	■	■	■	■
	64K	64K	256K	128K	256K	64K
	320	350	295	260	200	380
	300	300	300	307.2	330	300
	25,000	30,000	50,000	50,000	50,000	30,000
	Reveal IDE	Sony Proprietary	Future Domain SCSI	Todd Enterprises Proprietary	Future Domain SCSI-2	Wearnes Proprietary
	8-bit ISA	8-bit ISA	8-bit ISA	8-bit ISA	8-bit ISA	16-bit ISA
	2, 3, 5, 7	N/A●	3, 5	3, 5	3, 5	6
	8	4	4	8	5	5
	4	None	7	32	8	2
	□	□	■	□	■	□
	□	□	■	■	■	□
	Panasonic	Sony	Future Domain	Hitachi	Future Domain	Wearnes
	1.23	1.71A	2.3	3.0	2.4.1	1.01E
	□	■	■	■	■	□
	1.23	2.21	2.21	2.23	2.2	2.1
	■	□	□	■	□	□
	24 hours, M–Su	12:00–8:00 M–F	12:00–8:00 M–F	8:30–6:00 M–F	2:00–11:00 M–F	11:00–8:00 M–F
	■	■	■	■	■	□
	1 year	1 year	1 year	2 years	1 year	1 year

pushbutton on the rear of the drive allows you to select the SCSI address while other options are enabled with a small DIP switch. The internal termination of the drive is controlled by a slide switch.

Since a CD-ROM changer of this type is really not suitable for use on a large network (only one disk can be used at a time); nor does Pioneer recommend it for this type of application. Instead, the DRM-604X could be useful in a small-office environment where databases—phone directories, corporate listings, medical databases, and so forth—are often found on multiple disks.

▶FACT FILE

EDITORS' CHOICE Pioneer DRM-604X

Pioneer New Media Technologies Inc., Laser Optical Systems Group, 2265 E. 220th St., Long Beach, CA 90810; 310-952-2111; fax, 310-952-2100.

List price: *$2,045; includes external CD-ROM changer, caddy, SCSI cable, Future Domain TMC-1650 16-bit ISA SCSI adapter, installation software, manual and utilities; bare drive, $1,845.* Options: *device driver for Mac, $100; Future Domain TMC-850MER 8-bit ISA SCSI adapter, cable and manual, $100; PS/2 Micro Channel interface kit, includes Future Domain 16-bit MCS-350, cable, manual, $300.*

Circle 461 on reader service card

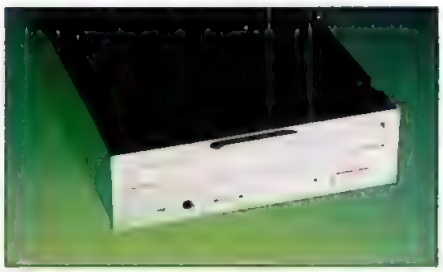
Plextor

Plextor DM-3028 DoubleSpeed PLUS

BY HOWARD ALEXANDER

For strong performance and a reasonable price, the Plextor (formerly Texel) DM-3028 DoubleSpeed PLUS is a solid choice. The company's newest double-speed unit, a strong performer on our tests, costs only $399 with an 8-bit SCSI controller. On the street, the price is around $370.

An Editors' Choice selection, the DM-3028 led the double-speed models on our Sequential Read test, and it placed above the average on our other tests. On our most demanding multimedia playback



The Plextor DM-3028 DoubleSpeed PLUS.

test, it skipped about 20 percent of the video frames—fewer than the majority of the units we tested. The DM-3028's Red Book audio quality (for playing audio CDs) was about average.

A clearly written, well-illustrated manual guides you through the installation. Jumpers let you select SCSI address, parity, speed, and similar options; two removable resistor packs on the bottom of the unit handle SCSI termination. The only hitch was that the supplied version of MSCDEX (Microsoft's MS-DOS CD-ROM Extensions) was incompatible with MS-DOS 6.0, a problem we also encountered with units from other manufacturers. DOS 6.0 includes an updated version of MSCDEX that eliminates the problem.

The mechanical characteristics of the DM-3028 are a bit unusual. The spring-

loaded door is heavy and requires two hands to load a caddy; when disks are ejected, they tend to shoot out of the drive ungracefully. A Plextor spokesman explained that this is a design consideration that is meant to prevent jamming problems that occur with certain CD caddies. Our original review unit failed during testing, but a replacement worked flawlessly.

The Plextor name may be a new one, but the DM-3028 leverages the company's experience in CD-ROMs. The Plextor DM-3028 offers an exceptional combination of price and performance.

▶FACT FILE

EDITORS' CHOICE Plextor DM-3028 Double-Speed PLUS

Plextor, 4255 Burton Drive, Santa Clara, CA 95054; 800-886-3935, 408-980-1838; fax, 408-986-1010.

List price: *$399; includes internal double-speed drive, Trantor T-130 SCSI interface card (8-bit ISA), cables, installation software. Bare drive, $329; Trantor T-130 interface card, $79; Future Domain TMC-1650 SCSI interface card (16-bit ISA), $459. External model (DM-5028): Bare drive, $439; Future Domain TMC-1650 interface card, $579.*

Circle 462 on reader service card

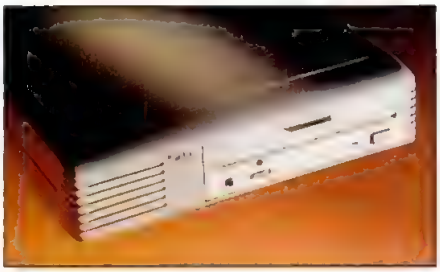
PLI Inc.

PLI CD-ROM MS

BY HOWARD ALEXANDER

Although originally intended for the Macintosh market, PLI's Toshiba-based PLI CD-ROM MS is equally at home on a PC. The CD-ROM MS is an external unit ($918 with a 16-bit SCSI-2 interface card; street price is about 20 percent less). An internal version (CD-ROM MS, with a list price of $608) is also available but was not provided for testing.

The CD-ROM MS package proved to be the fastest of the various Toshiba-based offerings, with very low CPU utilization in most of the multimedia playback tests, and with no video or audio dropouts. Scores on the Sequential Read, Text Search, and TIFF Image File Load tests were also very good to excellent. Red Book audio (for playing audio CDs) scores were average. Much of this high performance can be attributed to the better-than-average Future Domain TMC-1800 16-bit SCSI-2 host



The PLI CD-ROM MS.

card provided with the unit. In addition to being faster than other companies' offerings, this adapter allows access to the higher number of interrupts available in an AT-class machine (or better)—a very important feature if you're building a multimedia system.

Installation was not a problem, but you may have to fight the manuals. We received preliminary manuals that contained numerous errors and no illustrations (by the time you read this, the final manuals will be shipping). Even the Future Domain manuals had errors. Despite these impediments, the installation software was very easy to run. PLI provides software for controlling SCSI termination and a rotary switch to select the SCSI address. With the appropriate SCSI cable, the drive can be connected to a Mac, making it quite versatile in a mixed-platform environment.

▶FACT FILE

PLI CD-ROM MS

PLI Inc., 47421 Bayside Pkwy, Fremont, CA 94538; 800-288-8754, 510-657-2211; fax, 510-683-9713

List price: *$918; includes external double-speed drive with AC power, caddy, Future Domain TMC-1800 16-bit SCSI-2 interface card, 22-inch SCSI cable, driver software; Future Domain TMC-1800 16-bit SCSI interface kit incl. cable, drivers, $175; bare drive with caddy, $743; internal drive with Future Domain TMC-850 8-bit SCSI interface kit incl. cable and drivers, $608; Future Domain TMC-850 8-bit interface card with cable and drivers, $55.*

Circle 463 on reader service card

Procom Technology Inc.

Procom MCD-DS

BY JOSEPH DESPOSITO

Like the other Toshiba-based drives in this roundup, the Procom MCD-DS external double-speed CD-ROM drive was a good performer, producing excellent scores on our Text Search tests. The drive also turned in very good scores on the remainder of our tests, with the exception of our TIFF Image File Load test, where its 10-minute-44-second score can be considered only fair. Red Book audio results (for playing audio CDs) were above average.

The external MCD-DS we tested lists for $665, while the 16-bit Procom Xelerator-ISA/X SCSI controller we received with our drive lists for $359. The internal model of the tested drive (not supplied for testing)—the SiCD-DS— lists for $545. Approximate street prices are $525 for the MCD-DS, $500 for the SiCD-DS, and $225 to $250 for the Xelerator. The Xelerator-ISA/X is a SCSI-2 interface that lets you change parameters, such as throughput speed, by accessing software built into the board, a feature SCSI experts will relish.

Setup was straightforward, though the Install program froze on us, requiring a call to technical support. After adding to our CONFIG.SYS file a line indicating the presence of the Procom driver, installation proceeded smoothly. The MCD-DS supports CD-ROM XA and Photo CD single- and multisession formats, and the package

The Procom MCD-DS.

includes Photo Factory for Windows, a program that lets you view and manipulate photos on Kodak Photo CDs.

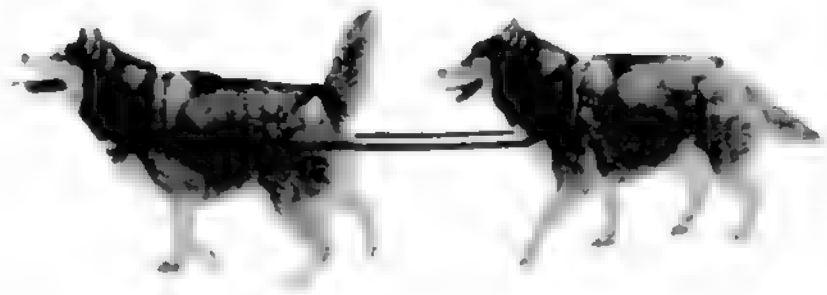
Procom sells this drive also as part of an MPC Level 2 upgrade kit called the Multimedia Station Pro, which comes with a Media Vision Pro Audio Spectrum 16 sound card and Fujikon CP668 speakers, in addition to eight CD-ROM titles for a total list price of $995 ($915 with an internal drive). At a street price under $800, this combo is an attractive buy.

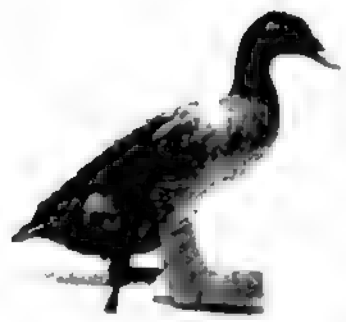
▶FACT FILE

Procom MCD-DS

Procom Technology Inc., 2181 DuPont

POKER CHIPS, SLED DOGS, AND DUCKS ON CRUTCHES





(WE'LL USE WHATEVER WE HAVE TO TO DEMONSTRATE THE ADVANTAGES OF LOTUS SMARTSUITE.)

Dr., Irvine, CA 92715; 800-800-8600, 714-852-1000; fax, 714-852-1221.
List Price: *$1,024; includes CD-ROM drive, caddy, Xelerator-ISA/X 16-bit SCSI-2 interface card, cable, terminator, drivers, setup software, Photo Factory for Windows software, rubber feet for vertical drive positioning; bare drive, $665. Xelerator-ISA/X 16-bit SCSI-2 interface card (incl. cables), $359; Multimedia Station Pro, including Media Vision Pro Audio Spectrum 16 and Fujikon CP668 speakers plus 8 CD titles, $995. Internal drive version: SiCD-DS, $904 with Xelerator-ISA/X 16-bit SCSI-2 interface card; bare drive, $545.*
Circle 464 on reader service card

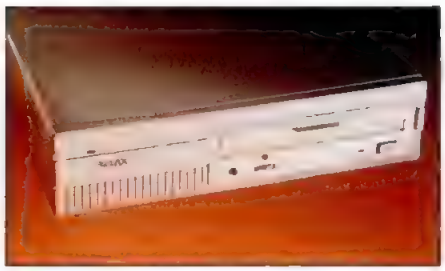
Relax Technology Inc.

Relax Vista Toshiba CD-ROM Drive

BY PATRICK HONAN

Relax Technology's double-speed Relax Vista Toshiba CD-ROM Drive serves up a winning combination of speed, features, and competitive price ($678—which includes a Trantor 130-B SCSI adapter). Relax sells direct, so you won't find discounts on this price. The Vista external drive is a repackaged unit based on the commonplace Toshiba TXM-3401E mechanism—thus the "Toshiba" in the product name.

On the whole, the Vista's performance was excellent. It placed in the top five on our Text Search tests and fared better



The Relax Vista Toshiba CD-ROM Drive.

than average on our TIFF Image File Load test. On our most complex multimedia playback test, it skipped about 20 percent of the frames, yielding 12 frames per second rather than the 15 sustained by the best drives. While not perfect, this performance was better than that of two-thirds of the tested double-speed models. The Vista also scored well above average on our Red Book audio quality tests (for playing audio CDs).

Installation was relatively smooth but not entirely trouble-free. Setting up the Trantor interface card was straightforward, but we had to modify CONFIG.SYS manually to specify the drive's location. A Trantor technician told us that this was caused by a conflict with MS-DOS 6.0, and that the company was working to fix the problem. Except for this initial hitch, the drive worked flawlessly using the installation software's default settings.

The Vista supports multisession Photo CDs and the CD-ROM XA standard. A self-cleaning lens and double-seal doors are welcome extras. The Vista's strongest aspect is speed, but it also delivers in terms of price, support for CD-ROM standards, and ease of use.

▶FACT FILE
Relax Vista Toshiba CD-ROM Drive
Relax Technology Inc., 3101 Whipple Rd., Union City, CA 94587; 510-471-6112; fax, 510-471-6267.
List price: *$678; includes external double-speed drive, Trantor T-130B SCSI interface card (8-bit ISA), cables, software. Bare drive with cables, caddy, $549; Trantor T-130B interface card, $129.*
Circle 465 on reader support card

Reveal Computer Products Inc.

Reveal CDD12

BY HOWARD ALEXANDER

The Reveal CDD12 CD-ROM kit from Reveal Computer Products is bundled with plenty of goodies: In addition to a Reveal IDE interface card, it comes with an instructional videotape detailing setup and includes 12 CD-ROM software titles. With its average performance and $399 list price (about $350 on the street), this double-speed drive should appeal to anyone who's looking for an inexpensive but capable internal CD-ROM reader.

The CDD12 placed squarely in the middle of the pack on most of our tests. The single exception was the TIFF Image File Load test, where this drive took third place among the tested double-speed drives. The unit's high signal-to-noise ratio and low total harmonic distortion scores

The Reveal CDD12.

on our Red Book audio tests (for playing audio CDs) are appealing. (We were unable to obtain a stable reading on our channel separation test, so no result is reported here.)

Reveal has managed to take what could be a tedious installation process and turn it into a simple—even enjoyable—affair. The manual is clear and concise, and it refrains from being unnecessarily technical. The drive comes with a videotape to guide you through the whole process; we found both hardware and software installation effortless. If you already own a SoundBlaster with CD-ROM port, you can hook the drive up to that, instead of using Reveal's provided adapter. And if your PC already includes an IDE controller, you can use that rather than the board that came with the unit we tested.

The CDD12 supports CD-ROM XA and Photo CD multisession recordings. With its low price, hand-holding installation process, and wealth of bundled software, the Reveal CDD12 CD-ROM is a bargain worth pursuing.

▶FACT FILE
Reveal CDD12
Reveal Computer Products Inc., 6045 Variel Avenue, Woodland Hills, CA 91367; 800-326-2222; fax, 818-340-3671.
List price: *$399; includes internal double-speed drive, Reveal proprietary interface card, cables, software, installation videotape. Included CD-ROM titles: The Software Toolworks Multimedia Encyclopedia, The Animals, Mavis Beacon Teaches Typing, The Software Toolworks World Atlas & U.S. Atlas, The Chessmaster 3000, Macromedia Action! SE for Windows, Clipmedia II SE, Where in the World is Carmen Sandiego?, The Secret Of Monkey Island, Secret Weapons of the Luftwaffe, LOOM.*
Circle 466 on reader service card

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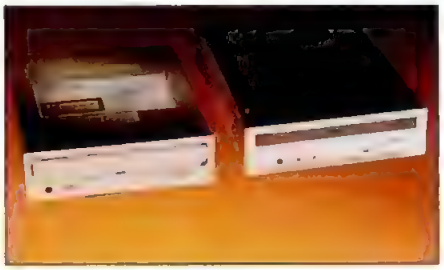
Sony Electronics Inc.

Sony CDU-33A
Sony CDU-561

BY HOWARD ALEXANDER

With a spectacularly low list price of $269.90, which includes a proprietary interface card, the Sony CDU-33A is Sony's new budget double-speed drive; street prices should be in the $210-to-220 price range by the time you read this review. The Sony CDU-561 is a moderately priced SCSI drive that came packaged with a Future Domain TMC-850 8-bit SCSI card and listed at $579.90 (street price is between $359 and $399).



The Sony CDU-33A and Sony CDU-561.

As with a number of other lower-cost units, the budget-priced CDU-33A does not use a caddy. Instead, there is a spring-loaded drawer on which you place the disk. An electronic release, triggered by either a front panel button or a software command, allows the drawer to open. The CDU-561, however, uses a caddy.

Both drives produced above-average performance, though the CDU-561 outperformed the CDU-33A by a small margin on all but two of our tests. While playing back our custom AVI (Audio-Video Interleaved) file, the CDU-33A dropped 103 off the 226 video frames; the CDU-561 dropped only 42. And on our TIFF Image File Load test, the CDU-33A edged out the CDU-561.

Since the CDU-33A comes with a proprietary controller, many of the potential SCSI-systems headaches have been avoided. Installation is very easy—you have only to select an unused port address for the board.

If any one word could be used to describe the Sony CDU-561 it would have to be "solid." While the unit breaks no speed barriers, its performance is quite respectable. The unit is well made, and its features are well thought out. The power-assisted loading/power-eject mechanism is very smooth and reliable. Installation of the SCSI drive was simple, and the manual is adequate for the job, with clear tables and illustrations.

We did run into a problem with the Future Domain controller board that Sony provides with the CDU-561. The model TMC-850 contained an old version of the BIOS (version 8.00), which prevented the drive from being located by the system. There are two solutions to the problem—either make sure you obtain the most recent version of the BIOS (Version 8.20) or just pop out the BIOS ROM that ships with the unit and don't replace it.

As expected, both Sony drives are compatible with audio CDs, Photo CDs (both single- and multisession), and CD-ROM XA disks.

While it would be nice (in theory) to have a CD-ROM that is a real speedster, having a unit that will perform solidly and reliably day after day is also important. If reliability is your primary concern, then the CDU-561 is definitely an appealing product. The CDU-33A is perfect for the budget user.

▶FACT FILE

EDITORS' CHOICE

Sony CDU-33A
List price: *$269.90; includes internal CD-ROM drive, Sony proprietary interface card, digital cable, audio cable, driver software. Bare drive, $199.95; OPA-4741 interface kit, $69.95.*

Sony CDU-561
Sony Electronics Inc., 3300 Zanker Road, San Jose, CA 95134; 800-352-7669.
List price: *$579.90; includes internal CD-ROM drive, caddy, 8-bit Future Domain TMC-850 SCSI interface card, SCSI interface cable, driver, mounting kit, software. Bare drive, $459.95. CDSINT interface kit, $119.95.*

Circle 467 on reader service card

Todd Enterprise Inc.

Todd Double Speed TCDR 2XM

BY STEVEN C.M. CHEN

The Todd Double Speed TCDR 2XM from Todd Enterprise is an external drive that's unusually well suited for use in a public terminal. Its performance was unexceptional, but the unit is built like a tank and has a lock to prevent unauthorized removal of a disk. The TCDR 2XM costs $1,009 with a proprietary controller card; it sells for about $700 on the street.

The TCDR 2XM was one of the slower double-speed drives we tested. It placed well below average on our Text Search test, and it dropped 90 percent of the video frames on the most demanding of our multimedia playback tests. On the easier multimedia playback tests, the drive's CPU utilization score was higher than average.

Instead of the usual RCA line-out jacks, the TCDR 2XM uses a miniphone (⅛-inch headphone-style) jack; the unit's Red Book audio quality (for playing audio CDs) was slightly below average for the tested drives.

The proprietary controller that Todd uses is a mixed blessing. Aside from adversely impacting performance, it limits your expansion options because it doesn't support SCSI. On the other hand, it will let you connect up to 32 CD-ROM readers—provided they're all Hitachi-manufactured (as the TCDR 2XM is).

The Todd Double Speed TCDR 2XM.

The TCDR 2XM supports CD-ROM XA disks and, as we went to press, it was being upgraded to handle multisession Photo CDs. While installing the TCDR 2XM is simple—the default settings worked well in our test-bed systems—the documentation provides only basic information and is not well organized.

An AC adapter and power cable are attached. Lack of SCSI compatibility and low performance limit the appeal of the Todd Double Speed TCDR 2XM, but the drive still offers promise where security is paramount.

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Hot Picks to Get You Going

by Robin Raskin

Can you hear that new CD-ROM drive just crying out to be fed shiny little silver platters? Here are ten surefire ways to start enjoying the medium and build a healthy collection.

Critical Path uses Hollywood film technique.

REFERENCE CDS

Microsoft Encarta: An encyclopedia is the cornerstone of any collection, and Microsoft Encarta is the flashiest of them all. The interface is comfortingly consistent and attractive. The text, based on *Funk and Wagnall's Encyclopedia,* comprises 25,000 articles augmented by digitized video, interactive animations, photographs, illustrations, and sound clips. (Microsoft Corp., 800-426-9400; $139.)

Global Explorer: The great thing about a CD atlas is the ability to zoom in and out of levels of detail. This handsome world atlas gets you close enough to see research centers on the Galapagos Islands, the city streets of Caracas, and more. As you mouse around, descriptions of more than 20,000 historical, cultural, and geographic features unfold. (Delorme Mapping Co., 207-865-1234; $169.)

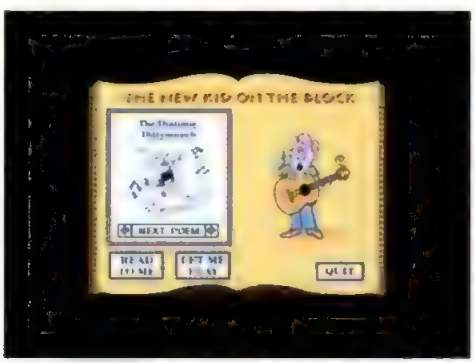
Random House Unabridged Dictionary: The perfect all-purpose digital dictionary, this edition contains 315,000 entries. The program's search tools are option-laden, and the entries help you with pronunciation and contain etymological information. A true bargain. (Random House Reference and Electronic Publishing, 800-733-3000; $100.)

COFFEE-TABLE CDS

Newsweek Interactive: In addition to giving you three months' worth of *Newsweek* magazine text, this CD breaks ground by bringing us "made for CD" journalism. Produced quarterly, each issue explores two original features. The latest, "Unfinished Business: Mending the Earth," mixes thought-provoking text, illustration, voice, and video to give the reader a look at what's ailing our environment. (The Software Toolworks, 800-234-3088; $49.95.)

Microsoft Cinemania '94: Capsule summaries of 19,000 movies and 4,000 in-depth movie reviews are the core of this delight. To flesh things out, there are movie-star biographies, video clips, cross references, interesting trivia, and plenty of sound clips. If movies are your passion, you'll definitely "play it again, Sam." (Microsoft Corp., 800-426-9400; $79.95.)

The Mayo Clinic Family Health Book: Learn anatomy by pointing and clicking on some extraordinarily detailed and beautiful drawings. Become knowledgeable about illnesses, drugs and their effects, and first-aid techniques. (IVI Publishing Inc., 800-937-6463; $69.95.)



Jack Prelutsky's poems are brought to life.

FOR KIDS

The New Kid on the Block: A recent entry in the Broderbund Living Book series, New Kid involves interactive poetry. The author, Jack Prelutsky, reads a selection of his notoriously funny poems aloud as whimsical characters bring the words to life. It's enough to make a poetry lover out of any kid. (Broderbund Software Inc., 800-521-6263; $39.95.)

America Adventure: This is the latest in a line of Knowledge Adventure products that turn subject matter into digital explorations. In this edition, you meet America's presidents, tour the country, learn about geography and regional culture—all via time lines, movies, sound, and interactive maps and animation. Other Knowledge Adventure packages explore dinosaurs, space, science, and undersea life. (Knowledge Adventure Inc., 800-542-4240; $79.95.)

FOR KIDS OF ALL AGES

Critical Path: This is a futuristic adventure that combines live movie characters with top-notch computer graphics. Not only do the characters look and sound real, they—depending on what you do—elicit real "attitudes" as well. Plenty of explosives, torture, and encounters with mutants. (Media Vision Inc., 800-845-5870; $64.95.)

Return to Zork: This classic has now found its way into CD format and is making the best-seller lists everywhere. You can save the empire from evil forces—only this time you've got a handsome interface, a thrilling soundtrack, and video footage to add to the experience. (Activision, 800-477-3650; $79.95.) □

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▶FACT FILE

Todd Double Speed TCDR 2XM

Todd Enterprise Inc., 224-49 67th Ave., Bayside, NY 11364; 800-445-8633, 718-343-1040; fax, 718-343-9180

List price: *$1,009; includes external double-speed drive with integrated AC adapter, caddy, Hitachi proprietary interface card (8-bit ISA), cable. Bare drive and caddy, $850; CD-LINK 8X+ kit, includes Hitachi interface card, cable, and software, $159; CD-LINK 5XM kit, includes TCD IS5A interface card (Micro Channel) with cable and software, $249.*

Circle 468 on reader service card

Toshiba America Information Systems Inc., Disk Products Division

Toshiba XM-3401B

BY HOWARD ALEXANDER

If the Toshiba XM-3401B somehow looks familiar, it's because this is the double-speed drive that about half the vendors here are selling under their own labels. Perhaps it's fitting, then, that the XM-3401B was a near-average performer with a near-average price of $845, which includes the SCSI adapter. On the street, you should be able to find the XM-3401B and card for under $500.

The XM-3401B was the top performer on our Random Read test, but it

The Toshiba XM-3401B.

fared only average on other tests. Multimedia playback performance wasn't perfect—the XM-3401B dropped about a third of the video frames in our most complex multimedia file—but it was generally strong. Red Book audio quality (for playing audio CDs) was generally above average, with the exception of channel separation performance, which was poor.

Although Toshiba's documentation is thorough and well illustrated, we ran into a minor snag when installing the drive and the supplied 8-bit Future Domain TMC-850 SCSI host adapter. The Toshiba-supplied version of MSCDEX (Microsoft's MS-DOS CD-ROM Extensions) proved incompatible with DOS 6.0. But DOS 6.0 itself contains a newer version of MSCDEX that sufficed. The installation software could use some refinement in terms of checking the system for possible address and IRQ conflicts.

The XM-3401B is also available as an external unit, either AC-powered (TXM-3401E, $895) or with a battery pack (TMX-3401P, $925). If you want Toshiba quality and performance, go straight to the source: The XM-3401B has the right features at the right price.

▶FACT FILE

Toshiba XM-3401B

Toshiba America Information Systems Inc., Disk Products Division, 9740 Irvine Boulevard, Irvine, CA 92713; 714-583-3111; fax, 714-583-3133.

List price: *$845; includes internal double-speed drive, caddy, Future Domain TMC-850 SCSI interface card (8-bit ISA), software. Bare drive and caddy, $695; Future Domain TMC-850 interface card, cable, drivers, sample CD-ROM disk, $150; PS/2 kit with cable, adapter, drivers, sample CD-ROM disk, $300. External model: Bare drive, $895. Portable (battery-powered) model: Bare drive, $925; battery pack, $100.*

Circle 469 on reader service card

Wearnes Technology Inc.

Wearnes Beethoven SuperSpin CDD-110

BY BILL DYSZEL

While most CD-ROM vendors are touting the benefits of SCSI, Wearnes Technology has opted for a proprietary interface for its $399 double-speed Wearnes Beethoven SuperSpin CDD-110. The drive can also hook up to any sound board that provides a Sony CDU-31A interface, including Wearnes' own Beethoven ADSP-16, a wavetable-based 16-bit sound board that lists for $199.

The primary advantage of this arrangement is cost: Eliminating a SCSI host adapter from the equation helps keep prices down (to as low as $279 on the street). It also means that there will be none of the address conflicts and termination problems that so often plague SCSI installations.

The tradeoff is performance. The CDD-110 turned in below-average results, taking longer than virtually all of the double-speed drives on our Text Search and TIFF Image File Load tests. This drive was also the only internal double-speed unit that dropped video frames on a 160-by-120-pixel multimedia playback test. But the dropped

The Beethoven SuperSpin CDD-110.

frames were infrequent enough that you probably wouldn't notice except on extremely rigorous sequences.

The drive's front-panel audio controls are a welcome feature: You can use them to play audio CDs and skip from track to track. And the drive offers raw digital output to comply with EBU (European Broadcasting Union) standards, which may be of interest to audio professionals. Yet the drive's Red Book audio quality (for playing audio CDs) is poor, with high intermodulation distortion and an extremely poor signal-to-noise ratio.

The CD-110 uses a motorized tray that makes a caddy unnecessary. The drive is bundled with Microsoft Bookshelf, which includes an encyclopedia, a thesaurus, an atlas, and other reference works.

The Wearnes Beethoven SuperSpin CDD-110 doesn't stand out for performance or Red Book audio quality, but it does offer low cost and trouble-free installation. □

▶FACT FILE

Wearnes Beethoven SuperSpin CDD-110

Wearnes Technology Inc., 1015 Brokaw Road, San Jose, CA 95131; 408-456-8838; fax, 408-456-8846.

List price: *$399; includes internal double-speed drive, proprietary adapter card, cables, software, Microsoft Bookshelf.*

Circle 470 on reader service card

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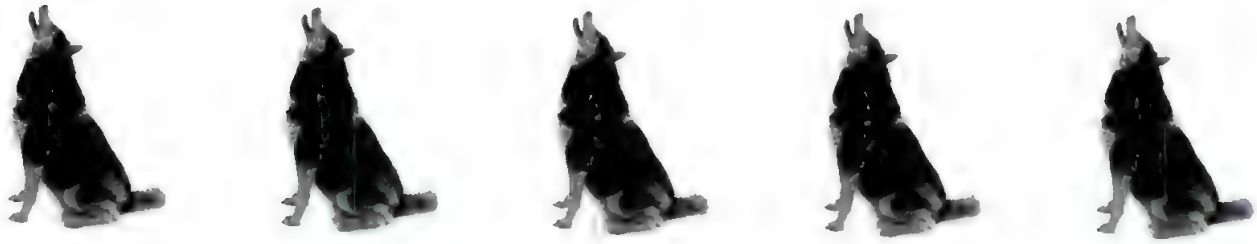

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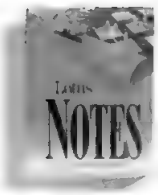

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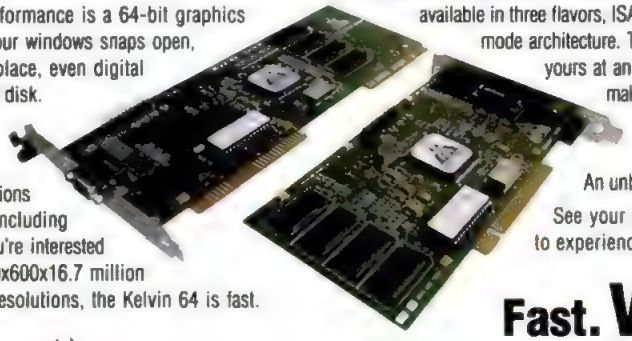

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CIRCLE 350 ON READER SERVICE CARD

KODAK PHOTO CD

A Photographic Memory for the Digital Age

While Photo CD may not have thrived as a consumer technology, it has emerged as the apple of the imaging professional's eye. We examine this subject so that you can find out why.

by Lori Grunin

Like Georges Seurat, Kodak paints images using only bits of color and light. Of course, the bits have long since evolved into binary digits, and color is now valued for its compressibility as much as its aesthetic appeal. And light—whether it's a laser that records and replays a compact disk or the glow of a pixel—has moved to center stage as digital imaging and optical storage take a larger role in the mainstream of our computing lives.

Although Photo CD (PCD) technology received a lukewarm reception from consumers after its initial appearance over a year ago, everyone involved in digital imaging has practically stampeded to support it. The rush has left Kodak filling a market vacuum that many of us were unaware even existed: A pent-up demand so large—in areas such as prepress, commercial and professional photography, image archiving, and electronic publishing—that PCD's success comes despite Kodak's marketing flubs and development misdirection.

Virtually every CD-ROM drive sold today reads multisession PCD disks, and every important graphics application can (or will soon be able to) open PCD images. Too, an increasing number of CD—recordable (CD-R) drives can write PCD Portfolio disks, and vendors such as Apple and Silicon Graphics have agreed to build PCD support into their oper-

Photography by Geoff Spear

H I G H L I G H T S

Photo CD

DESPITE PHOTO CD'S less than enthusiastic response from consumers, digital-imaging professionals in prepress, commercial and professional photography, image archiving, and electronic publishing have rushed to jump on the bandwagon.

PCDS ARE DISKS containing scanned photographs at different resolutions that can be viewed on almost any computer platform or on a TV set. Future incarnations may also contain sound, video, and the ability to navigate the disk via a predefined menu system.

BECAUSE THE IMAGE PAC, PCD's storage area, uses repeated sampling, it throws out less data than other lossy compression schemes. It doesn't, however, attain the extreme levels of compression that other schemes do.

SINCE PCD USES a write-once technology, adding subsequent images to a partially empty disk during another session requires that sections in need of updating be duplicated wholesale. Consequently, every session you add takes up approximately 25MB additional per session.

KODAK HAS LAGGED in software support for PCD in the DOS/Windows community. Since application vendors have to license Kodak's PCD Software Developer's Kit, there is little leeway for speeding up the process of opening PCD files.

BE CAREFUL about which PCD transfer service you use: Some photofinishers tend to lack the necessary knowledge about PCD services. Go by personal recommendations if you can find any.

ating systems. All this activity on both the demand and supply sides has helped spur technological progress in related areas, such as 6X CD-R drives and 3X CD-ROM readers (multispin drives that run at six times and three times normal speed).

When someone hands you a PCD, they're giving you a disk containing scanned photographs, each in a variety of resolutions. In the near future, this disk may also contain sound and the ability to navigate the disk via a predefined menu system; in the distant future, video may be included as well. You view the disk on almost any platform using a CD-ROM XA drive—DOS/Windows, Macintosh, Silicon Graphics, and Sun—or even on your television using devices such as Philips CD-Interactive (CD-I) players, Kodak's Photo CD players (see the sidebar "No PC Required"), or the newer products from Panasonic based on 3DO's technology.

The plethora of currently available PCD-based products illustrates the technology's myriad uses. From Alice to Ocean, the most widely publicized PCD product to date, is only the first of several photography books to use PCD as an electronic publishing tool. Mountain Travel Sobek and Custom Process used beta Portfolio software (Kodak's authoring package) to create "The Adventure Disk," a narrated travelogue about some of the more remote reaches of the globe.

More corporate applications include Dayton Hudson Corp.'s kiosk-based holiday gift guide. And this winter, Kodak launched the Kodak Picture Exchange, an on-line service that gives subscribers sophisticated search tools for navigating low-resolution versions of 17 stock-photography agency libraries, although the initial front end is Mac only. Connect-time charges amount to $85.20 per hour, but this more convenient method of performing picture searches can save you hours.

If you'd like to liven up your presentations but want to avoid the fees associated with stock photography, CDs full of clip images are the perfect alternative. Unlike stock photos, which you may only use once, clip images are yours to use however and as often as you'd like. Clip image libraries, such as Corel Corp.'s Professional Photos CD-ROM ($49.95 each; Ottawa, Ontario, Canada; 800-836-3729, 613-728-3733; fax, 613-761-9276) and Digital Stock Professional's offerings ($249 each; San Diego, California; 800-545-4514, 619-794-4040; fax, 619-794-4041) are relatively inexpensive sources of high-quality images.

PAC-ING IT IN

But what's all the fuss about? Why can't existing formats like TIFF combined with existing CD standards serve the same purpose? Understanding PCD's potential impact on your computing life requires delving beneath the idea of a PCD as simply "a bunch of pictures on a disk" and analyzing the implications of its underlying technology, marketing, and applications.

Rather than imagining PCD as a single format or product, think of it as a group of products, with the Master Photo CD disk at the center of a hub-and-spoke-shaped family tree that currently comprises the Pro Photo CD Master, Print Photo CD, Photo CD Portfolio, Photo CD Medical (scheduled for release in February 1994), and Photo CD Catalog disks.

All of these disks share a common structure, but each uses the structure differently. The most important element of the structure—as well as one of Kodak's core innovations—lies with an element known as the Image Pac, the actual image storage area. If you examine a directory listing from a PCD, you'll notice a PHOTO_CD directory with files named IMGxxxx.PCD. Each of these files constitutes an Image Pac for a given picture, which contains all the information needed to reconstruct the image at five separate pixel resolutions: 3,072-by-2,048 (16Base); 1,536-by-1,024 (4Base); 768-by-512 (Base); 384-by-256 (Base/4); 192-by-128 (Base/16). In addition, Pro Photo CD also offers a 64Base resolution of 6,144-by-4,096, which is stored in a section known as the Image Pac Extension (IPE). (Keep in mind that when Kodak specifies the resolutions, it reverses the dimensions, giving the vertical resolution first.) As yet unimplemented higher resolutions have also been announced.

Our Contributors: LORI GRUNIN is a frequent contributor to and a former associate editor of *PC Magazine*.

No PC Required

by Lori Grunin

Despite the underwhelming response to its initial consumer Photo CD products, Kodak gamely continues to pursue the home market. Besides providing native PCD support in various non-Kodak consumer electronic devices—including Philips CD-Interactive and 3DO players—Kodak hopes to spur adoption by offering a line of Philips-manufactured, Kodak-branded players that display PCD images on a standard television. While all of these players double as capable CD-audio units and are priced to compete with similarly configured audio-only models, they still present a more attractive alternative for the business presenter and kiosk creator than the occasional photographer.

The PCD players come in four basic models with RF, composite, and S-video connections; hooking them up is as simple as installing a VCR. Once you have them set up, they're as easy to use as an audio-only unit. All offer a variety of controls for navigating and viewing images. They also let you view selected images, choose and save specific sequences in which to play back images (called Favorite Picture Selection, or FPS), autoplay a sequence, rotate and pan images, and play a disc in reverse (useful for photos taken with cameras that load the entire roll of film and shoot from the end to the beginning, such as the Canon EOS Rebel). You can operate these players via front panel controls or remote control.

That about sums up the capabilities of the bottom-of-the-line PCD 270 (list price, $379; you can find it for a street price of around $170). One important capability lacking in the 270 is a full-image display: While the Base image (768-by-512) was intended for NTSC display, in practice the images overscan slightly, which causes them to be cropped on all sides.

The higher-priced models—the PCD 870 ($449), the five-disc carousel PCD 5870 ($549), and the portable PCD 970 ($449, manufactured by Hitachi)—compensate for this by zooming out to fit the full picture on-screen. With these models you can also zoom in on a selected area and scan through a disk, and they provide increased memory to store a larger number of FPS lists. The 5870 gives you an on-screen list of the loaded disks, both PCD and audio. Finally, the 970 is the only player that currently supports ADPCM audio, and thus will fully support Portfolio-authored discs that incorporate sound.

The portable unit, which is the same size as its audio-only kin and can run on four AA batteries, is a good substitute for slides in image-based presentations on the road: you can create custom FPS lists for individual client sites with less fuss than juggling slides and carousels. On the other hand, once you start using PCD, you may find yourself juggling disks instead.

Overall, flipping through pictures on TV surpasses using a slide projector, both in your living room and in the boardroom. The images look terrific: their increased contrast, highly saturated colors, and broad tonal range improve photos that might otherwise look poorly exposed or washed out when printed or projected. The units automatically compensate for the televsion's interlaced display to provide a steady picture, although one by-product of viewing a full image is an irritating flicker at the top of the image against the black background.

But Kodak will have to continue developing new strategies to reach the home market. While any of these players complements PC use and can serve well for kiosk-type applications, as yet they provide no compelling reason for consumers to adopt them. □

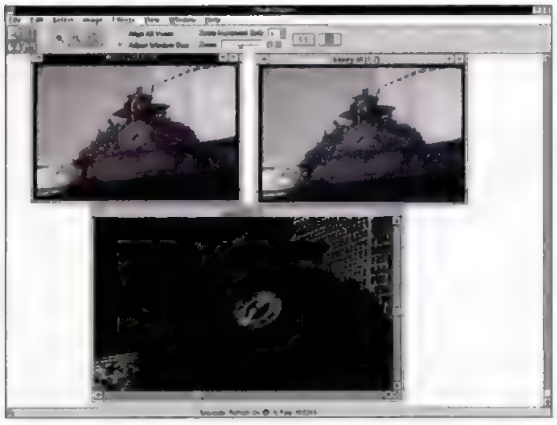
Uncompressed, the 16Base image would require slightly less than 18MB of disk space. Instead, Kodak uses a lossy compression scheme to shrink the entire five-image set down to between 2.9MB to 6.5MB per Pac, depending upon the complexity of the image.

The Pac creation process begins with scanning the original at the 16Base resolution (64Base for a Pro PCD) using specially designed PCD scanning hardware—an RGB CCD scanner that picks up 12 bits per primary color. The scanner acts as a colorimetric reference device, which means that it encodes the image data as if it were acquired by a device with specific, predefined characteristics. In this case, it assumes that the original scene was illuminated by a light source with a temperature of 6,500 degrees Kelvin (CIE Standard Illuminant D65), and that the light sensitivity characteristic of the CCD matches that of CCIR 709 display phosphors—the recommended specification for HDTV. Adhering to these standards ensures that the resulting PCD files will look "correct" when displayed on standalone players and that the applications you use to open PCD images know exactly what type of color characteristics to expect.

The Image Pac format throws out very little data, but it can't attain the extreme levels of compression that other schemes do.

The input media—35-mm negatives or slides in the case of a standard PCD Master disk and 4- by 5-inch transparencies or smaller in the case of a Pro PCD disk—have a much greater spectral sensitivity range than is allowed for by a 24-bit RGB encoding based on CCIR 709 phosphors. For instance, areas on a transparency that look clear and that would by all accounts register as 100 percent white if simply clipped during the RGB encoding actually contain valuable highlight information; similarly, seemingly black areas that include shadow information would require

negative RGB values. (For those who would like more information about the mappings, the Kodak white paper "Fully Utilizing Photo CD Images: Using Information Beyond 100% White," is available as PCD001 .TXT in the Photo CD general library of the Kodak CD forum on CompuServe.)



Here, we simulated the creation of residuals in the luma channel. The tonal range was decreased only in the darkest areas to make them visible to the naked eye.

So one of the most important operations during the image acquisition process is remapping the 36-bit values in the initial scan so that the most information possible ends up in the final 24-bit image. (To obtain the exact conversion equations, request *Kodak Photo CD Products: A Planning Guide for Developers,* available from Kodak at 800-235-6325, ext. 53.)

At the same time, different brands and types of film have specific color and tonal characteristics. Some Fuji films, for example, produce bright colors but reproduce skin tones poorly, while some Kodak films accurately reproduce skin tones but yield photos that have an overall orange cast. In addition, all negative films have an amber coating that improves contrast when creating prints but looks hideous when directly scanned. Kodak's scanning software provides color-correction look-up tables called Scene Balance Algorithms (SBA) to compensate for the differences among film types.

The RGB data is then converted into Kodak's proprietary "color encoding metric" (similar to color space), PhotoYCC, whose primaries consist of one luma (Y) and two chroma (C) channels. Just as with the separate luma color spaces used by other lossy compression schemes such as JPEG, YCC makes it possible to perform greater compression in the chroma channels—where you're less likely to spot artifacts—than in the luma channel. Using the YCC space also makes it possible for Kodak to store the images in a way that's optimized for display on TV.

REPEATED SAMPLING

The Image Pac format actually throws out very little data—far less than other lossy compression schemes—but it can't attain the extreme levels of compression the other schemes do. Basically, it works by storing successively smaller versions of the largest image, as well as residual information that allows it to add information back when interpolating up to higher resolutions.

More specifically, the software takes the 16Base image and subsamples each channel down to a quarter of the size (50 percent horizontally and vertically, a process called 2X subsampling) and stores the new image in memory. Then it performs a 2X subsample on the new image so that you now have two images: one a 2X subsample of the original, the other a 4X subsample.

The software then interpolates the 4X subsampled image back up to the size of the 2X image and compares the two; it then stores the differences for all three channels, called residuals (the process is known as decimation). The residuals are compressed using lossless Huffman encoding.

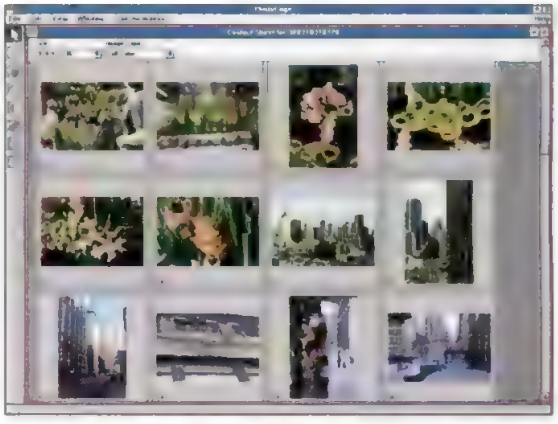
In a similar process, the 4X subsampled image is shrunk yet again by 2X and 4X. In this case, however, only the luma channel is interpolated up and residuals stored; all the chroma information remains. The image is then successively subsampled down to the lowest resolution. In the end, an Image Pac contains three full-resolution images (Base/16, Base/4, and Base), plus luminance and chrominance residual information that's used to enhance the higher-resolution images created by interpolating up from the Base resolution. On a Pro PCD disk, the decimation process begins with a 64Base-resolution image and the residuals for all three channels are stored in the IPE area.

Since the images at Base resolution and below are relatively small and used in quick-retrieval situations, such as for thumbnails or for viewing on a TV with a standalone player, compressing them further makes little sense. The thumbnails are also used to generate index prints, a contact-sheet type of dye-sublimation print that accompanies each PCD. Each numbered image on the index print corresponds to one of the numbered Image Pacs.

WRITING THE DISK

PCD disks are mastered on CD—recordable drives; master disks use special Kodak-produced media specifically designed for greater durability and longevity. Their most distinctive trait is a gold reflective layer, which the company claims is more resistant to oxidation than the aluminum-based layer used in traditional CDs. Kodak also claims that its dye layer, made with a scratch-resistant plastic outer coating, is more stable than that used by other CD recording media. Kodak estimates the life of the disk at 100 years; only time will tell how accurate the estimate is.

At the sector level, all PCDs are rigidly structured and comply with the Green Book format for write-once CDs, a cross between CD-ROM XA and CD-I. The Green Book compliance gives PCD its basic cross-platform compatibility.



Pictured is an example of an OVERVIEW.PCD file loaded as a contact sheet by Kodak's PhotoEdge software.

Aside from the Image Pac, other important files written to every PCD disk

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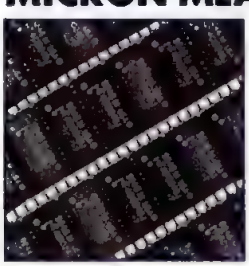

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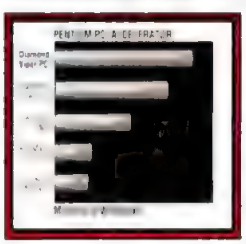

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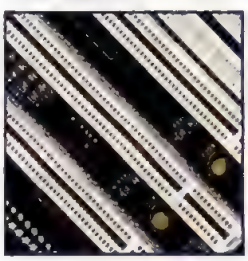

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- 1MB Flash BIOS by Phoenix
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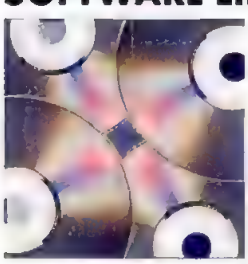

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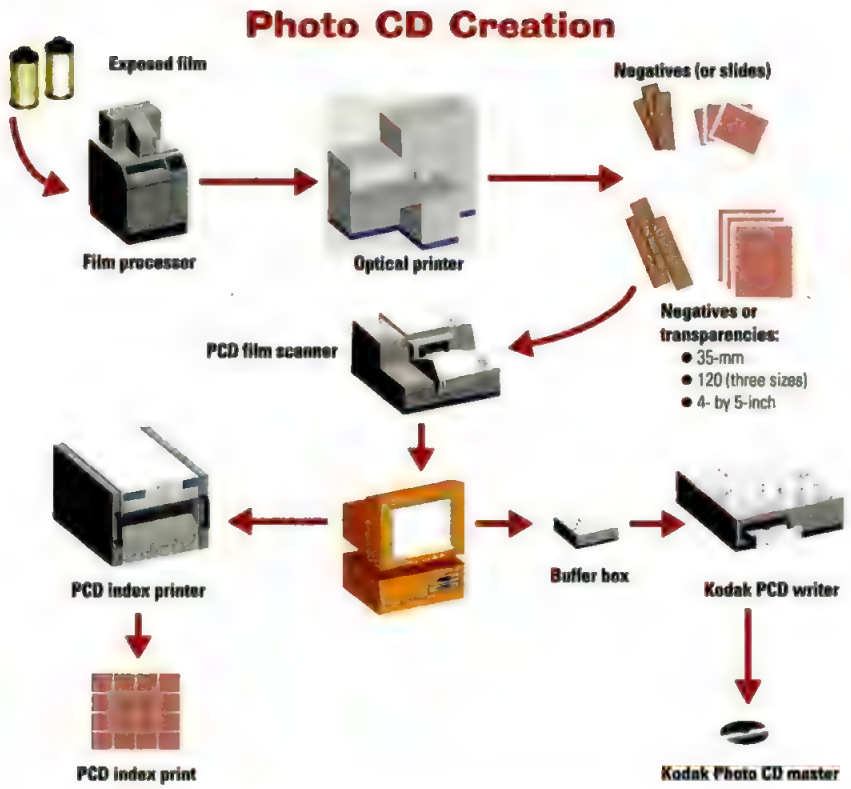


include a file of the Base/16 images, called OVERVIEW.PCD, that provides ready-made thumbnails for applications that support its display. You'll also find a CD-I directory that contains code necessary for displaying images on standalone players.

Since PCDs use a write-once technology, adding subsequent images to a partially empty disk during another session means that sections in need of updating, such as the OVERVIEW.PCD and the directory structure locations, must be duplicated wholesale. As a result, every session you add takes up extra space—approximately 25MB per session—and it's in your best interest to save up your photos and have them transferred in one shot. In addition, your CD-ROM drive needs to understand how to search for and use the secondary session information, hence the recommendation that you purchase a "multisession-capable" drive.

Each disk has a unique 12-digit serial number whose last 4 digits indicate the lab that wrote the initial session; standalone players key stored Favorite Picture Selection (FPS) sequences to the serial number. While they share a common structure, the various disk types use that structure in specific ways to store different types of information. As already mentioned, the Pro PCD uses the IPE area to store residuals for higher-resolution images, as does the PCD Medical format, which is intended to accommodate files in formats standard to the medical imaging industry. The Print PCD is identical to the standard Master but also stores CMYK TIFF images scanned in by high-end drum scanners from companies such as Linotype-Hell, Scitex, and Crosfield; Print PCD also allows the operator to store images in a user-selected color space.

PCD Portfolio, which makes use of the Image Component Information (ICI) sectors, is the multimedia-supporting format. Among other things, the ICI holds an image-orientation flag, interleave information, and ADPCM audio attributes. The Portfolio format supports continuous-play ADPCM (Adaptive Difference Pulse Code Modulation) as well as Red Book audio clips. All playback information for systems and players that don't support ADPCM audio—including branching, audio annotation, and play sequences—is contained in a file called PLAYLIST.PCD; systems that do support ADPCM audio get their instructions from EXTPLAY.PCD. Portfolio disks will also support smaller Image Pacs, such as those containing only Base-resolution images and smaller.

PCD Catalog stores images only in the Base/16 resolution; the operator can store 4 images in the space otherwise used to accommodate the Base image, or 16 images in the space used for the 4Base (end users see only individual thumbnails when they retrieve them). As a result, the Catalog can store around 4,400 images compared with an estimated 100 for the standard PCD Master (the number of images you can fit on a Pro PCD depends upon the size of the input media). A Portfolio CD can store up to 800 images (at the largest size, without sound) or 72 minutes of sound.

Kodak and Philips also have a licensing program to enable mass reproduction of PCD disks for large-scale distribution. You take a Master, Pro, or Portfolio disk to an authorized manufacturer, and the manufacturer will replicate the disks on the same media used by regular CD-ROMs.

THE SOFTWARE PROBLEM

Aside from viewing PCD images using standalone players, you have a variety of software options depending upon your needs. Although Kodak offers its own applications—such as Shoebox, an image-database product; PhotoEdge, a basic image-retouching program; and Access, a simple viewing utility that clip-image vendors can include on their CDs—for working with PCDs, mainstream image-editing, illustration, and desktop publishing packages can also work with PCD files and allow you to select from image resolutions from Base/16 through 16Base.

Similarly, although Kodak's Portfolio authoring software also offers the most basic capabilities (for instance, all text must be added in another application and rasterized onto the background image), Kodak has published the specifications for the scripting language that the front end uses to generate the final code, making it possible for more mainstream or sophisticated multimedia authoring software products to incorporate Portfolio support into their applications.

Kodak has been extremely open about many aspects of PCD technology, but the actual file format is not one of them. In

order to be able to read PCD files, application vendors license the PCD Software Developer's Kit (SDK) from Kodak, which provides the code necessary to open PCD files and convert them from YCC to other color spaces.

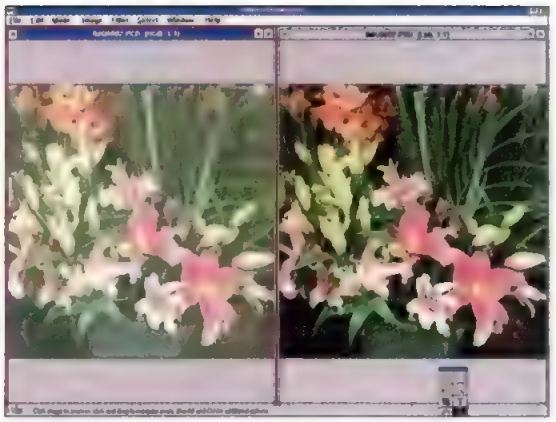
Unfortunately, Kodak has not responded as quickly to the needs of the DOS/Windows community as to those of Macintosh users. The current shipping Windows SDK does not include support for opening Pro PCD files (at 64Base resolutions) that the Macintosh kit does. Also for the Macintosh version of Photoshop, Kodak ships a plug-in PCD Acquire module that includes the ability to select advanced options such as gamma and color temperature when opening a PCD image; a similar Windows plug-in is not expected until mid-1994. Furthermore, vendors such as Micrografx have been outspoken about feeling neglected by Kodak.

One bright spot under Windows is Aldus PhotoStyler 2.0's integration with the Kodak Color Management System (KCMS). As part of its color-handling duties, the KCMS module lets you choose a look-up table based upon whether your original medium was negative or transparency film.

These seemingly esoteric issues aren't quite as irrelevant to Josephine User as you might think. First, the control that Kodak maintains over opening the files leaves software vendors little leeway for speeding up the process. In casual testing, using a Toshiba 3401 double-speed CD-ROM drive, it took us just under 3 minutes to open a 16Base image with PhotoStyler 2.0 on a 486/66 VESA local-bus system with 16MB RAM, a typical configuration for a non-graphics-intensive user. Since the 16Base image reconstitutes to 18MB, it required spooling to the hard disk, which slows down the operation.

More heavily loaded systems used by people accustomed to working with full-color images will speed load, but not significantly enough to suit high-pressure production work, a problem that will be compounded once Pro PCD support comes to the PC. Also, keep in mind that images with the rotation flag turned on (so that they automatically load in portrait orientation) take longer to load than they would if opened in landscape orientation.

The ability to control color conversion more finely is even more crucial to the end user. Despite Kodak's efforts to make PCD color as device-independent as possible, many pitfalls remain. Relying on the YCC-to-RGB algorithms results in highly imperfect display and print quality. For instance, many images will appear to have burned-out highlights, when in fact that information has been stored by the mapping process mentioned earlier.



These are identical images retrieved from a PCD. The one on the left was converted to RGB using Photoshop's conversion algorithms, the other to the LAB color space. Note the significantly different appearance.

THE PRICE OF PROGRESS

Apart from the various disk formats, you'll have to consider other factors: the high-cost scanners used to acquire images; Kodak's proprietary software for scanning, performing color space conversion, image compression, and Image Pac creation; CD-R writers for mastering the disks; and a variety of end-user applications for accessing and manipulating the images. While Kodak offers products in all of these categories, only a small fraction of these tools are proprietary (although as of this writing, only the end-user applications are available for the PC).

Because of the high cost of the hardware—Kodak's turnkey systems, which include a scanner, Sun-based workstation and software, and CD-R drives currently run upwards of $100,000—only service bureaus and serious corporate sites can justify going into Photo CD production. Other vendors, such as Fuji, also sell turnkey PCD imaging stations, but none come cheap. (For more information about the pros and cons of investing in PCD creation tools or recording hardware, see *Inside Photo CD: Market Opportunities in a Leading Edge Technology* ($195; The Color Resource, 708 Montgomery St., San Francisco, California 94111-2104; 415-398-5337; fax, 415-398-5339).

The largest installed base of PCD-creation sites are photofinishers. To have a disk created, you drop off your negatives, slides, and transparencies the same way you now get prints developed. (For a list of PCD-capable photofinishers in your region, contact Kodak at 800-235-6325, ext. 53.)

As we went to press, not all of the various disk formats were available. The workstations and software used to create Pro disks are in late beta testing at sites around the country, such as ZZYZX (a division of A&I Imaging, Hollywood, California; 818-996-3914) and Advanced Digital Imaging (Fort Collins, Colorado; 800-888-3686; fax, 303-482-0334).

Widespread Portfolio authoring awaits the release of the software, which consists of a front-end application that assembles the audio and images and defines the branching structure plus a back-end application that performs the actual recording to disk. The Sun back end will ship first in 1994, and the first release of the front-end software will be for the Macintosh; the complete Portfolio for Windows system will be ship later in 1994. The initial release of the recording software won't support interleaving.

Many factors affect the pricing of PCD transfer services, not the least of which is the market's current state of flux. We've found the cost of transferring a set of 35-mm negatives to a standard Master PCD is anywhere from $0.49 per frame scanned to $4.00 each. Most services base charges upon the number of frames and whether or not you also get your film developed at the same time.

There's always a charge of around $10 for the disk, or a $1 or $2 charge for adding another session to an existing disk. Usually providers will also charge about $2 to $3 for a source change—a change of input media, such as switching from nega-

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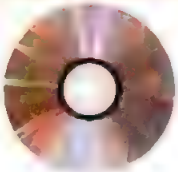

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tives to slides. So, for example, at $1.59 per scan, using a Kodalux service for transferring 36 predeveloped exposures to a new PCD will cost about $67.24; the same operation performed by a low-cost service such as LazerQuick Imaging Services (Beaverton, Oregon; 800-937-9196; fax, 503-641-5151) is less than half that price.

At the moment, pricing for PCD creation is still searching for its long-term plateau. For instance, services such as Best Photo Labs (Brookfield, Connecticut; 800-428-2377, 203-775-2377; fax, 203-740-1183), set artificially low prices during 1993 ($0.89 for a scan of a predeveloped slide or negative in quantities of 5,000 or more) in order to attract customers and allow them to gain experience with the process and its pitfalls. They expect to restructure their pricing, probably to a higher level, in early 1994.

Standard negative-to-print processing of a 36-exposure roll can cost less than $10. Because even the least expensive equivalent PCD processing—36 transfers to an existing disk—costs more than twice that, it's not surprising that consumers haven't stampeded for disks. On the other hand, PCD represents a windfall for midrange corporate users and publishers who might normally have to spring for $20 or more for a drum scan to get comparable images.

Assuming a halftone line screen of 150 lines per inch and choosing a resolution of 1.5 times that for output (a reasonable situation for producing high-quality color pages), you can obtain a high-quality 8- by 10-inch print from a 16Base image. Furthermore, a PCD automatically includes the low-resolution placement-only scans. It also makes an attractive alternative to purchasing a color flatbed scanner for people who do relatively low-volume work or who want better quality scans than they can get from a $1,200 400-dpi unit.

Pro PCD transfers tend to cost a lot more than standard Master ones. For instance, ZZYZX charges $20 to scan a 4- by 5-inch transparency at 64Base resolution; Advanced Digital Imaging charges $15. In part, this higher price reflects the higher cost of the scanner used for Pro PCD transfers; with the lower-resolution scanner for creating Master disks, all scanning and correction works automatically, while the higher-resolution Pro scanner includes software with professional tools for the use of more experienced technicians.

Keep in mind that an equivalent drum scan might run you over $50. While PCD doesn't render drum scans (with their higher resolutions) obsolete, it certainly puts the squeeze on traditional service bureaus and probably on their prices as well.

BE DEMANDING

Eventually, transfer pricing should signal the potential quality of the final scans; in other words, higher-priced scans will reflect greater operator intervention in the form of color correction and other retouching services, as well as turnaround times.

Based on our small-sample testing experiences using a variety of services—ranging from the low-cost LazerQuick and Best Photo Labs to the highest-priced service we could find, K & L Tartaro Photographic Imaging (New York, New York 10017; 800-622-6277, 212-949-8191)—there's certainly room for labs to distinguish themselves by offering extra services.

For instance, unless you specify otherwise, slides will be scanned still in their mounts (Master only; Pro PCD scans slides unmounted). While this doesn't affect the overall image quality, you will notice that all the images have a black border around them. It may be worth your while to pay extra for an operator to remove the borders before committing the images to disk.

Don't treat PCD transfers as you do film developing or assume all flaws in your photos reflect poor photographic skills.

Also, all scans—whether from a $100 hand scanner or a $100,000 Personal Imaging Workstation—will need some retouching. At the very least, you can visibly improve any scanned image with a quick Unsharp Masking (which boosts the contrast of the image).

To get the most out of PCD imaging services, you might need to be a bit savvier than when dealing with a photofinisher. Don't treat PCD transfers the way you do film developing, and don't assume that all the flaws in your photographs are the result of poor photographic skills. For example, strange color casts in the images may indicate that the operator loaded the wrong SBA for your film type. Similarly, if you used a certain film type because of its particular characteristics, you can request that the SBA be turned off during the session (although professionals are still discussing the role of the SBA and when to ignore it).

Note the black border—the area between the picture and slide mount—around this image scanned from a 35-mm slide.

If you're sensitive about the image quality and often demand special handling of your jobs, you're better off paying higher prices and working with a photofinisher used to dealing with professional photographers, or one who has proved responsive to your needs. More forward-looking providers also have representatives that can answer questions online in places such as CompuServe (the most heavily trafficked PCD discussion areas are in the Kodak CD forum and the Photography forum).

Overall, we were extremely happy with all the scans as well as the providers we dealt with, although none of the images displayed or printed properly without some correction. In some cases, this may be because even a PCD scanner can't turn a poorly exposed picture into a work of art. The one operator error we encoun-

tered was quickly redone at no charge.

The providers we tried, however, were either used to serving professional photographers or were personally recommended to us. Some photofinishers—especially those accustomed to sending jobs off to a third-party service such as Kodalux—tend to be poorly organized or ignorant when it comes to PCD services.

Kodak's assumption that the product's primary use would be for display on TV sets has exacerbated the problems of color matching.

PRESENT IMPERFECT

Of course, not all of PCD's problems can be blamed on the messenger. Kodak's assumption that the product's primary use would be for display on TV sets has exacerbated the problems of color matching that already plague the microcomputer world. To appear attractive on TV, images need to be more saturated and more contrasty than they might otherwise be. In order to compensate, Kodak allows printers to be "Photo CD–aware" and automatically reduce the contrast when printing PCD images.

The system's inability to handle photographic print-scanning directly presents another drawback. For instance, a PCD's longevity makes it a very attractive alternative to videotape for archiving old photographs. But if you don't have negatives, the only way to transfer the pictures is either by scanning them yourself (or having them scanned by a service bureau) and put on a Print PCD—an unnecessarily expensive solution—or by having negatives made by a photofinisher, another expensive process that also degrades the quality of the image.

Of course, PCD's extensible format implies that we can't rule out future technologies and disk types. But even now the different PCD product lines—Master, Pro, Print, Portfolio, Catalog, and Medical—are starting to become a bit unwieldy to keep track of. A Pro disk, for example, doesn't necessarily have to store the extra 72MB version of an image; if you have a 4-by-5 original, it must be scanned on a Pro-capable station and therefore output on a Pro disk, even though the Image Pacs are otherwise identical to a standard Master. In other words, *you* have to be aware of the differences in input technology. Furthermore, since PCD scans are always RGB, gray-scale images take up more space than necessary.

Warts and all, Photo CD has clearly appeared at the right moment with a solid solution. By offering an extensible storage and retrieval technology for the disk-hogging media of the present and future—and attempting to deal with the sticky issues of cross-platform compatibility and color reproducibility—Kodak has charted a course that many of us will follow into the next era of the digital age. □

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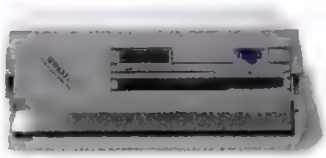

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CD-ROM ON THE LAN

Sharing a CD-ROM

Whether you decide to go with peer-to-peer or with a shared or dedicated CD-ROM server, this is not like sharing other resources over your network.

by James Karney

It would seem to be the perfect match: networks and CD-ROMs. Networks allow people to share resources throughout an organization. CD-ROM technology uses an inexpensive medium that can store and retrieve vast amounts of data. As enticing as it is, though, bringing the two together is no small matter. You can get there from here, but the road to sharing a CD-ROM on a LAN—at least right now—is marked by hardware-connectivity and drive-mapping pitfalls.

Just what will work best for you depends on your network situation and the level of performance you need. Proper planning is essential. If there is a CD-ROM program you must run or certain data your users must access, you must make sure the method and product you select are compatible with your network and user community before you buy. Many vendors will work with you toward this goal.

The basic task in using a CD-ROM on a network is moving data from the CD-ROM to a client system. Here we take a brief look at a few approaches and at some representative products

Photography by Geoff Spear

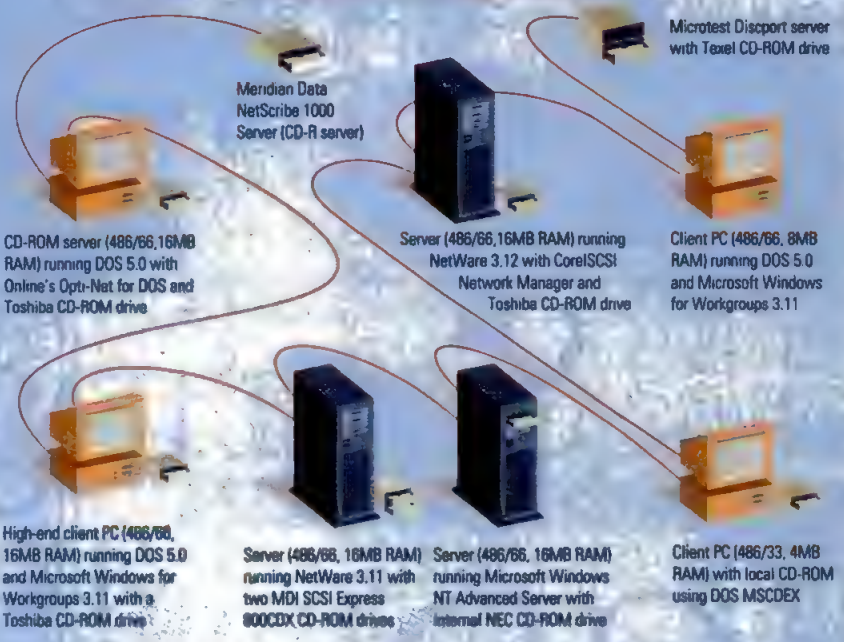
How We Tested

To investigate the principal challenges in providing access to CD-ROMs over a network, we constructed a small mixed Ethernet LAN with three servers and five nodes running NetWare 3.11 and Microsoft Windows for Workgroups 3.11. During testing we changed the LAN configuration and experimented with various hardware combinations. Although our informal testing did not place severe loads on the drives, it did produce some interesting results. We found that each approach carries trade-offs.

To evaluate operations with a standard file server, we connected a pair of Micro Design International's SCSI Express 600CDX CD-ROM drives with MDI's software and a Toshiba TXM-3301E CD-ROM drive using the CorelSCSI Network Manager NLM on a NetWare 3.11 file server. To test in a peer-to-peer arrangement, we reconfigured one station as a server using Microsoft Windows NT Advanced Server and a dedicated DOS CD-ROM server with an internal NEC MultiSpin 84i CD-ROM drive. A Windows for Workgroups client shared another Toshiba TXM-3301E.

Our network included two dedicated CD-ROM servers: Microtest's Discport with a Texel DM-5024 CD-ROM drive and one DOS client configured with a Toshiba TXM-3301E using Online Computer Systems' Opti-Net for DOS. We also tested Meridian Data's NetScribe 1000 Server, which supports write-once CD—recordable (CD-R) media.

Test-bed Configuration



OUR TEST-BED

Our NetWare server was a Micronics-based 486/66DX2 with 16MB of RAM, an Adaptec AHA-2742T SCSI-2 host adapter, a 2GB CorelRAID subsystem running three IBM 662 disks, a Toshiba TXM-3301E CD-ROM drive, and an Eagle 3200 NIC.

All the server-mounted CD-ROM systems we tested were connected using the AHA-2742T and the existing ASPI software. The clients were all 486-based systems running Windows for Workgroups 3.11 under DOS 5.0 and were connected using thin coaxial cable with Eagle NE 2000plus NICs.

that get you there. Although the products we looked at all move data to the client, the real challenge is in assuring that your users can run the programs they need, while you also limit access to those with proper authorization. And although our tests did not place severe loads on the CD-ROM drives, they did uncover some interesting results.

CD-ROM VS. CD-ROM VS. CD-ROM

Three basic approaches are used in establishing CD-ROM access on a network: a peer-to-peer setup, a combination file/CD-ROM server, or a dedicated CD-ROM server. These approaches can be used in combination with local drives to meet almost any need. Peer-to-peer solutions, such as Microtest's Discport, are excellent options for a simpler network situation in which security is not a key issue. Keep in mind that solutions suited to smaller installations without heavy traffic or high security needs tend to exact a price in memory overhead and performance.

The file server approach is centralized and offers better performance and tighter control, but it requires more ongoing management. If you have to swap disks often, this approach may prove a burden. A high-volume solution usually requires its own memory cache and a dedicated server in order to reach full utilization.

Some products, such as the SCSI Express 600CDX, from Micro Design International, will run on a shared file server but perform better from a dedicated system. Products that use redirection to turn a PC into a dedicated CD-ROM server, such as Online Computer System's Opti-Net, usually offer excellent security and management (the payoffs for dedicating a system). This approach can allow a client to access a CD-ROM on the server without loading MSCDEX (MS-DOS CD-ROM Extensions) locally, thus reducing local overhead while still allowing access to the drive. In some cases, the extensions may still need to be added to allow access to local applications. If your installation will generally keep the same disks loaded all the time, then setup demands are not a problem, and the path and permissions can be configured just once.

MORE HEADACHES

Mounting. CD-ROM drives use large-capacity *removable* media. But the fact that the data can be changed so easily—just by changing the disk—makes managing access to the contents more complicated than with stationary forms of storage. Someone must change the disks, and it

takes time to mount the several gigabytes of data from them onto a server for access.

Network-ready? Also consider two other aspects of building a CD-ROM library: Not all applications in CD-ROM format are network-ready, and of those that are, not all come with multiuser licensing. Some applications are limited by hardware requirements, performance, or mandatory path locations. You would need to purchase a special version of Computer Select, for example. Investigate fully before you buy.

Format. The other matter is the way files are organized. CD-ROMs are sequential devices, unlike hard disks, which are random devices. This explains, in part, why they are slower. But most CD-ROMs used with PCs do comply with ISO 9660, an international standard that defines the data format. In addition, some newer operating systems, such as Microsoft Windows NT and NetWare 4.01, have a native ability to read ISO 9660.

MSCDEX. Most OSs, though, require some form of translation utility or redirection. The most popular is MSCDEX, which ships free with DOS 6.0 (but third-party versions are available). Many CD-ROM applications require you to load some form of MSCDEX, while others perform redirection on the fly. The catch is compatibility. We found some applications that would run on a networked CD-ROM, but the disk's data could not be recognized without the network MSCDEX.

Mapping. Another compatibility wrinkle comes in handling path statements and mapping volumes. Many programs load search software on the hard disk, then expect to find the CD-ROM data at a specific drive letter. If a client maps the data to a different logical drive the application will report an error.

Multimedia. Multimedia support can create problems as well. ISO 9660 supports the mixing of data files with audio clips and animation on the same platter. In theory, you could mount a multimedia disk on a server and let users run a presentation on their own machines. One question, though, is where does the sound come out—at the server or at a client? That depends on how the application was written. In many cases, a client station can access the program but cannot play music locally. In addition, sound and animation create extremely large files that make for a lot of traffic over the wire. An animation that takes 7 minutes on a local drive can stretch to a jerky 20 minutes over a busy network.

KEEP IT SIMPLE (IF YOU CAN)

The simple approach will work for many small workgroups, including those that use peer-to-peer software, such as Artisoft's LANtastic or Microsoft Windows for Workgroups. With DOS-based CD-ROM products, users will still need to load any drivers for the SCSI bus and CD-ROM drive, as well as MSCDEX, then use the network's share commands to allow other users to access the drive.

We tested that approach over Windows for Workgroups, making sure to load a recent version of MSCDEX with the "/s" share option. All other Windows for Workgroups stations were able to see and use data files on the host PC but were unable to play audio tracks. The 5-user version of Computer Select ran without problems in a DOS window on one client.

Our Microsoft Windows NT Advanced Server configuration was the easiest of the OSs to set up with CD-ROM capability. Advanced Server itself installs from a CD-ROM and can automatically identify supported SCSI host adapters and CD-ROM drives. Windows NT has embedded support for both ISO 9660 and MSCDEX. To allow clients access to files, we only had to set up the account permissions.

THE NETWARE FACTOR

NetWare 3.12 and 4.01 allow you to mount a CD-ROM volume directly on an existing dedicated file server using their own NetWare Loadable Modules (NLMs). The drawback is the time it takes to mount and unmount the volume. If you do not need to remove or replace a platter very often, or you have a lot of calls on the CD-ROM volume, the built-in NLM is as easy as it gets. If, on the other hand, you have a lot of other traffic, the CD-ROM drive can clog the system, and frequent disk changing not only eats up staff time but limits ready access to the drive.

One solution is to use a product that reduces the time required to swap disks on the server. We tested two third-party file server solutions under NetWare 3.11: CorelSCSI Network Manager and SCSI Express 600CDX.

EASY, INEXPENSIVE

CorelSCSI Network Manager is an excellent choice, especially if you have existing

How to Reach the Vendors

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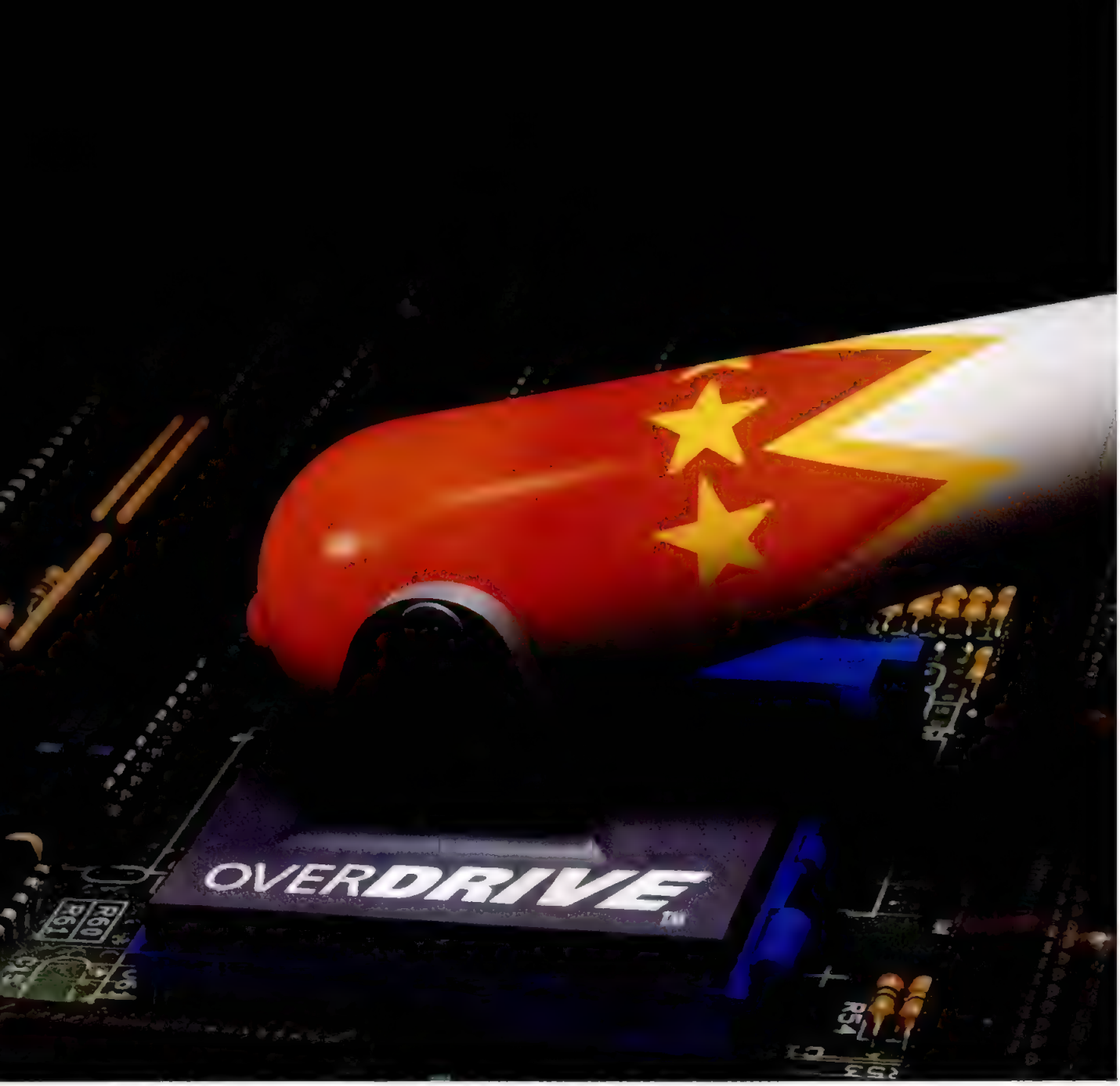
List price: *$595.*
Corel Corp., 1600 Carling Ave., Ottawa, Ontario, Canada K1Z 8R7; 800-836-7274, 613-728-8200; fax, 613-761-9176.
Circle 482 on reader service card

Discport
List price: *$795.*
Microtest Inc., 4747 N. 22nd St., Phoenix, AZ 85016-4708; 800-526-9675, 602-952-6400; fax, 602-952-6401.
Circle 483 on reader service card

NetScribe 1000 Server
List price: *With 5-user software license, $9,995.*
Meridian Data Inc., 5615 Scotts Valley Dr., Scotts Valley, CA 95066; 800-767-2537, 408-438-3100; fax, 408-438-6816.
Circle 471 on reader service card

Opti-Net
List price: *Opti-Net for DOS, MSCDEX, 8-workstation license, $795; 100-workstation license, $1,495. Opti-Net VAP, with SCSI adapter, MSCDEX, 100-workstation license, $1,795. Opti-Net NLM, MSCDEX, 100-workstation license, $1,495.*
Online Computer Systems Inc., 20251 Century Blvd, Germantown, MD 20874-1196; 800-922-9204, 301-428-3700; fax, 301-428-2903.
Circle 472 on reader service card

SCSI Express 600CDX
List price: *External, $795; internal, $645.*
Micro Design International Inc., 6985 University Blvd., Winter Park, FL 32792-6713; 800-228-0891, 407-677-8333; fax, 407-677-8365.
Circle 473 on reader service card



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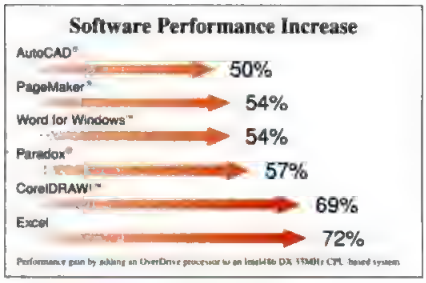

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SCSI and CD-ROM hardware to be networked. At $595, CorelSCSI requires that its own NLM be loaded on the server, and that a driver and some form of MSCDEX be installed on each client. Users access a database created by the NLM from the CD-ROM; this speeds up operation and delivers extra security.

The CD-ROM drive letter must be mapped at the client, and the setup routine handles most of the installation work automatically. (Keep in mind that remapping the drive letter later can cause software failure for any drives that rely on the old path statement.) The NLM is used to mount and unmount volumes, set the amount of dedicated CD-ROM cache, and determine the size of the workspace buffer. The administrator must then physically mount the disk. Setting up and running CorelSCSI went flawlessly, and it worked with client PCs running both Corel's own CorelCDX and MSCDEX.

GOOD FOR MACS, TOO

Micro Design International (MDI) uses a similar technique with its SCSI Express, which can be purchased together with CD-ROM drives housed in interlocking external enclosures. Like CorelSCSI, SCSI Express requires an NLM to be loaded on the server and the drive's volumes to be mounted there. In this case, however, MSCDEX is not required on clients.

Although MDI sells full packages complete with SCSI host adapters, the software and drives can be connected to any NetWare-compliant ASPI (Advanced SCSI Programming Interface) adapter. We installed the dual-drive, multisession SCSI Express in about 5 minutes on a server. A few minutes later all the clients on the network had mapped the drives and could use them along with local CD-ROMs.

We had no trouble running our multivolume PhoneDisc database or switching between platters on the SCSI Express and the client. Mac clients also can access the drives, so SCSI Express is a good choice in NetWare/Apple environments.

SOMEWHERE IN BETWEEN

Microtest's Discport ($795) is a hybrid—a dedicated CD-ROM server that uses an NLM but does not reside on the server. From a box about the size of a VHS tape, it supports up to seven CD-ROM drives and runs without requiring MSCDEX. The Discport has a 25-pin SCSI connection on one end and both thin coaxial cable and twisted-pair fittings on the other.

The network administrator can limit access or link access to certain groups, as well as obtain statistics on usage using Discview Windows-based software. We ran into some difficulty after the NLM was loaded on the server and the Discport had been set up as a logical device under Windows. The software would mount the drive on the server, but could not see the volume in the attached CD-ROM. We swapped the drive with the drives on the client and server to no avail. We finally replaced the Toshiba TXM-3301E drive with a Texel DM-5024 drive (supplied by Microtest), which allowed the system to mount the disk and to read data. We then added the CD-ROM in the middle of the SCSI chain, and Discview saw it with no problem.

A write-once disk called CD-R (recordable) can be used in conventional CD-ROM drives.

The Discport supports most of the features called for in the SCSI-2 standard, except for active termination. This exception is what caused the difficulty just described. (Microtest says it now offers a SCSI termination power adapter for $40, which will be built-in on the next release.) Another plus for multiple drive installations would be support for disconnect/connect, allowing a device to drop off the bus while it completes a task, then send the results later.

There was no need to load any drivers on the clients once the unit was set up; we just ran the NLM on the server and mapped the drive using Discview. The software is well-designed and quite intuitive: The drag-and-drop interface made it easy to mount and manage volumes from the client. You must be careful, though, in mapping drives. It is all too easy to swap drive letters, potentially leading to problems. Users might select a location that will not work with applications requiring access to the disk on a specific path. Overall, the Discport is a slick solution for workgroup-style environments that have moderate CD-ROM needs and run NetWare.

ON YOUR OWN

CD-ROM is cheap in quantity—durable, unaffected by magnetic disturbance, and free of most hazards that prey on other computer storage media. Its principal limitation is its read-only nature.

Early users had to go through a complex and expensive mastering process to obtain a disk. That is changing (well, sort of). Philips, Sony, and others are offering machines that accept a write-once disk called CD-R (CD-recordable) that can be used in conventional CD-ROM drives. The disks, although somewhat sensitive to heat and light, are still more stable than the average hard or floppy disk. A CD-R has a capacity of 550MB for about $18 and much faster access than tape. It is not only good for low-volume CD-ROM production, but it could be used for backup. This is still, however, a relatively pricey approach.

To test the CD-R approach, we attached a NetScribe 1000 Server ($9,995), from Meridian Data, to our network. The unit has built-in Ethernet and uses redirection to communicate with clients, which must have a TSR loaded to see the drive. We copied about 500MB of files from a NetWare 3.11 volume to the CD-R on the NetScribe. This process took a few hours, but the final result worked well in a regular CD-ROM. A few cautions about working with the drive aside, the NetScribe offers a viable solution for anyone who wants to archive data for ready retrieval on a network.

ROM FOR IMPROVEMENT

We managed to connect and share CD-ROMs effectively with all the approaches we tested, but we could not run all programs or access all disks we tried in each. And we ran into some interesting hardware and drive-mapping snafus.

With the increasing use of CD-ROM for software distribution, however, and the growing library of commercial CD-ROM databases, we can expect to see increasing OS support and more third-party solutions. But until integration catches up to need, situating CD-ROMs on a network will continue to require thoughtful planning and careful installation. □

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Power PC: *Your Next CPU?*

PowerPC sounds like every user's dream: fast, inexpensive, and largely compatible with existing applications. Is this the processor family that will redefine computing?

by John Clyman

Every new generation of software demands more computing power, and if you think there's any end in sight, you haven't seen the technologies just over the horizon. Desktop video and telecommunication, handwriting and speech recognition, object-oriented operating systems: They all burn CPU cycles. It won't be long before today's flagship machines will be overpowered by the next generation of operating systems and applications, just as 286 systems were made obsolete by the mass acceptance of Microsoft Windows.

The question is, can Intel's venerable *x*86 architecture maintain its dominance as demands for computing power continue to grow? The first implementation of the Pentium, manufactured on a 5-volt, 0.8-micron process, foreshadows the design challenges ahead: It's big and power-hungry. Intel will address these problems this year, when it begins fabricating Pentium chips on a 3.3-volt, 0.6-micron process, but its competitors aren't waiting to put the pressure on.

Apple Computer, IBM Corp., and Motorola are betting that their jointly designed PowerPC family of RISC processors will draw buyers away from the Pentium and its successors. RISC offers a number of fundamental technological advantages over CISC: relatively

Photograph by Pierre Goavec

small sets of simple, hardwired instructions that execute rapidly; pipelined designs that break instruction execution into manageable steps, enabling superscalar designs that execute multiple instructions simultaneously; and large register files that, coupled with a load /store design, substantially reduce slow memory accesses. These factors mean RISC can provide blazing performance, low manufacturing cost, or anything in between.

The line between RISC and CISC is blurring: Intel CPUs from the 486 onward have co-opted some of these techniques. Still, maintaining compatibility with the enormous installed software base presents an additional design burden for Intel.

The RISC-versus-CISC debate is not a new one, but PowerPC is uniquely appealing among the current crop of RISC processors (see the sidebar "PowerPC: How It Stacks Up" for more information). Some of PowerPC's key strengths:

- PowerPC promises broad operating-system and software support. It will also benefit from virtually guaranteed early acceptance on two key platforms: Apple's Macintosh and IBM's RS/6000 workstations.
- The first PowerPC chip, the PowerPC 601, is roughly as fast as the Pentium, but it costs only about half as much, largely because of its small 11- by 11-mm die size (see the sidebar "PowerPC: A Family Portrait" for more information).
- PowerPC's architecture is designed to be widely scalable; later processors should run at higher clock speeds and embrace aggressive performance-enhancing techniques without presenting serious design difficulties.

THE CHALLENGES AHEAD

A technological head start is not enough to ensure a processor's widespread acceptance, though, and PowerPC faces a series of difficult challenges in the marketplace.

PowerPC: *A Family Portrait*

by John Clyman

Just as *486* describes an entire series of processors with varying characteristics, *PowerPC* defines an architecture that can be implemented in numerous ways; there is no single chip that is PowerPC. To date, Apple Computer, IBM Corp., and Motorola's highly publicized PowerPC road map includes four distinct processors: the PowerPC 601, PowerPC 603, PowerPC 604, and PowerPC 620. Each processor places a different emphasis on performance, power consumption, and price (see the accompanying table for more information). IBM and Motorola will independently design other PowerPC products, including a series of embedded controllers.

Most of these first PowerPC processors will be 32-bit CPUs, such as the initial PPC601 that began shipping last fall. (The "PPC" prefix is IBM terminology; Motorola uses the mnemonic "MPC" instead.) At its top clock speed of 80 MHz, the PPC601 should prove slightly faster than a 66-MHz Pentium. For scientific and engineering applications, the PPC601's highly optimized floating-point unit should set it well ahead of the Pentium.

The PPC601 is manufactured by IBM on an efficient, 0.6-micron, four-metal-layer CMOS process. The 0.6-micron geometry results in a relatively small die size, which helps keep manufacturing costs down. Using four metal layers rather than the three used in many other CPUs eliminates the pad ring that normally surrounds a processor core, further reducing size and cost.

The PPC601 was designed to hit the market rapidly and is in many ways a transitional product. It diverges moderately from the PowerPC architectural specifications, in part so that it can act as a better bridge to the IBM POWER (Performance Optimization with Enhanced RISC) architecture from which it draws heavily. Also, the PPC601 runs on 3.6 volts—a compromise between the 5 volts required for current Pentium implementations and the 3.3 volts that most processor manufacturers are aiming for.

PORTABLE POWER

The second PowerPC processor, the PPC603, is about as fast as the PPC601 but has an entirely different design: The

PowerPC Processors at a Glance

	Key design goals	Scheduled full-scale production	Clock speeds	Price per chip (in lots of 1,000)	Register size	Operating voltage	Typical power consumption	Maximum number of instructions per cycle	Cache size	Manufacturing process
PowerPC 601	Strong price/performance ratio, fast arrival on market, multiprocessor capability	Currently being produced	50 MHz, 66 MHz, 80 MHz	$303 (50 MHz), $387 (66 MHz), $545 (80 MHz)	32-bit	3.6V	8W (80 MHz)	3	32K (unified)	0.6-micron, four-metal-layer CMOS
PowerPC 603	Low power consumption	Mid-1994*	66 MHz, 80 MHz	Info not available	32-bit	3.3V	3W (80 MHz)	3	16K (8K for code, 8K for data)	0.5-micron, four-metal-layer CMOS
PowerPC 604	Strong price/performance ratio, multiprocessor capability	Early 1995*	Info not available	Info not available	32-bit	3.3V	Info not available	4	Info not available	0.5-micron, four-metal-layer CMOS
PowerPC 620	High performance, multiprocessor capability	Early 1995*	Info not available	Info not available	64-bit	3.3V	Info not available	6	Info not available	0.5-micron, four-metal-layer CMOS

* Projected

In order to expand into the mainstream of desktop computing, PowerPC machines must provide competitive price/performance ratios, be available from a variety of vendors, run the operating systems that users demand, and offer compelling software applications that aren't available elsewhere. This last point is the most significant: Simply matching the capabilities of Intel-based PCs will not be enough to sway the massive inertia of the installed base.

It might appear that PowerPC's low manufacturing cost gives it an inherent price/performance advantage over the Pentium. In fact, it's meaningless to talk about the performance of a chip without considering the software it's running. To run the bulk of *x*86-specific software that exists today, PowerPC machines must resort to performance-sapping emulation techniques (see the sidebar "Software: You *Can* Take It With You" for more information). Overcoming this obstacle means convincing developers to port their applications to PowerPC, a task at which only Apple has so far proved successful.

Inducing third-party system manufacturers to adopt PowerPC may prove tough, too. At the time of this writing, no vendors of mainstream desktop PCs (aside from Apple and IBM) had endorsed PowerPC. To ease the design burden on manufacturers interested in pursuing PowerPC, IBM and Motorola have jointly developed the PowerPC reference platform (PReP) specification. The PReP spec defines the characteristics of a variety of possible PowerPC configurations, including desktop PCs and laptops. The standards set by the PReP spec should also help software developers ensure compatibility with machines from different manufacturers.

Operating systems should present little impediment to PowerPC, since Apple, IBM, and Motorola have garnered support for almost every 32-bit operating system you could imagine. AIX (IBM's vari-

PPC603 is optimized for use in portables and energy-saving desktop machines. Besides running on a lean 3.3 volts, it provides extensive power management capabilities, including the ability to shut down inactive portions of its circuitry. These features offer the possibility of a Pentium-class laptop computer.

IBM and Motorola are now shipping the PPC603 in sample quantities at 66 MHz and 80 MHz. Full-scale production is expected within the next few months.

SCALING THE PERFORMANCE LADDER

The PPC604, scheduled for mass production early next year, will nearly double the performance of the PPC601 by implementing two integer pipelines. Apple, IBM, and Motorola will target the PPC604 at high-end desktop machines, workstations, and network servers.

Not long thereafter, IBM and Motorola will begin producing the PPC620, a 64-bit implementation of the PowerPC architecture. Few details of the PPC620's design have been disclosed, but we expect it will couple PPC604-class integer performance or better with phenomenal floating-point capabilities. The PPC620 is intended for extremely high-performance applications; it will most likely find a home in superservers and processor clusters for mainframes and supercomputers.□

HIGHLIGHTS

PowerPC

POWERPC, A JOINT EFFORT of Apple Computer, IBM Corp., and Motorola, will be Intel's toughest RISC competitor. PowerPC promises broad operating-system support and provisions for handling existing software.

APPLE IS BETTING the ranch on PowerPC: Within two years, all new Macintosh systems will use PowerPC processors. PowerPC-based Macs will look and feel like 68000-based models. Apple is porting much of its system software and will provide transparent, built-in emulation for existing applications.

TWO IBM DIVISIONS have announced plans for PowerPC systems. The Advanced Workstations & Systems division has already rolled out its first PowerPC-based machines, RS/6000 workstations running AIX. And the recently formed Power Personal Systems division will develop mainstream PowerPC systems. A key component of its strategy: "human-centered" interfaces that permit "natural" input, perhaps via handwriting and speech recognition.

THIRD-PARTY SYSTEM designers have so far proved reluctant to commit to PowerPC. With the exception of Apple and IBM, no makers of desktop PCs have yet announced plans for PowerPC-based units. But IBM is providing reference designs and selling core-logic chip sets, so designing systems should not be difficult.

POWERPC PROCESSORS are slated for everything from portable communication devices to desktop PCs to massively parallel supercomputers. IBM describes its strategy as "palmtops to teraflops."

THE FIRST POWERPC chip, the PowerPC 601, is targeted at desktop systems; it promises Pentium-class performance at an attractive price. The forthcoming PowerPC 603, designed for low power consumption, will appear in high-end notebooks and "green" PCs. The second-generation PowerPC 604 and PowerPC 620 chips will offer even greater speed.

MICROSOFT WINDOWS NT is one of numerous 32-bit operating systems that will eventually run on PowerPC. Others include AIX, NetWare, PowerOpen, Solaris, System 7, Taligent, and Workplace OS (which will run OS/2). Existing *x*86-specific software will be largely supported via Insignia Solutions' SoftWindows and SunSelect's Wabi.

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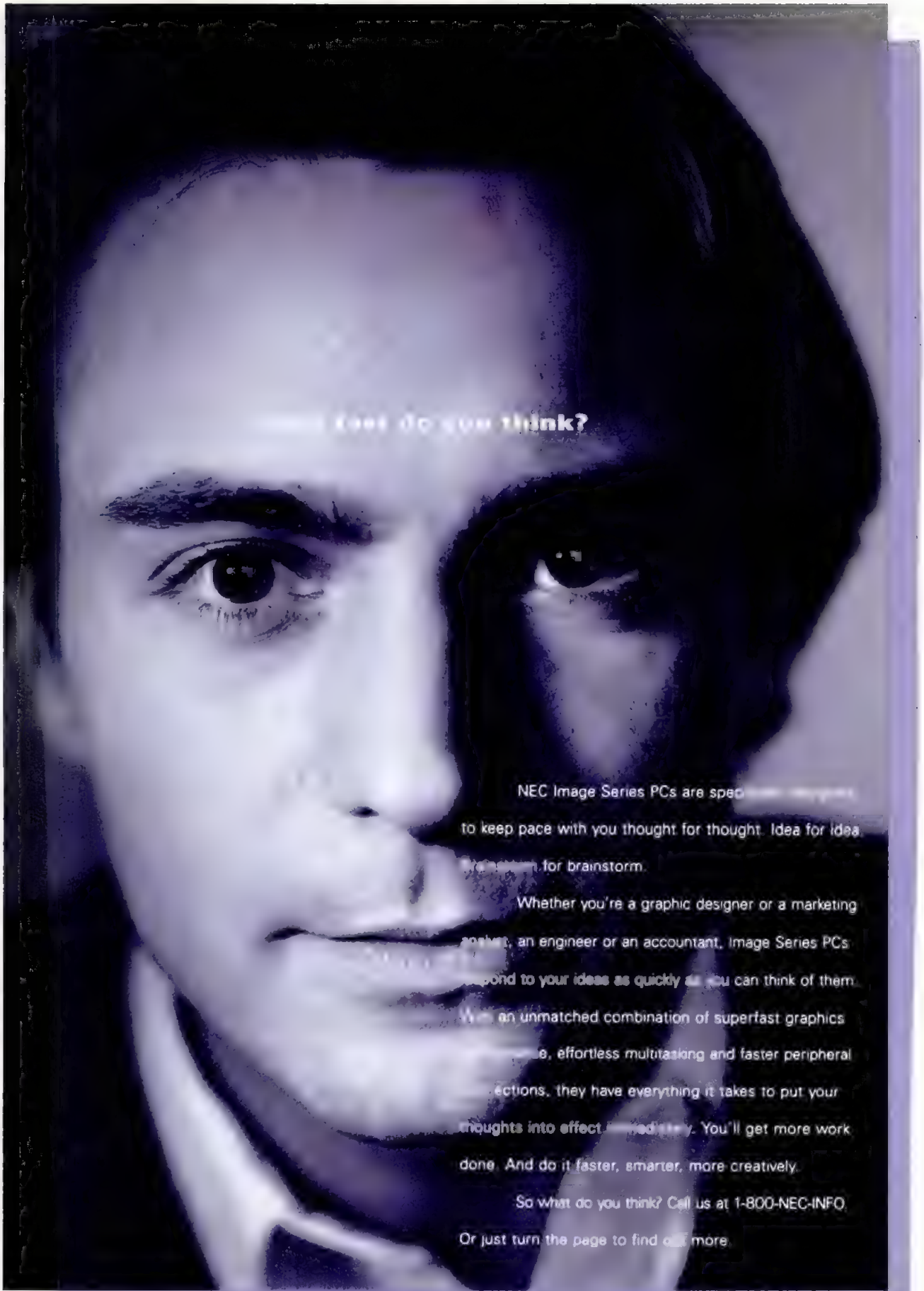

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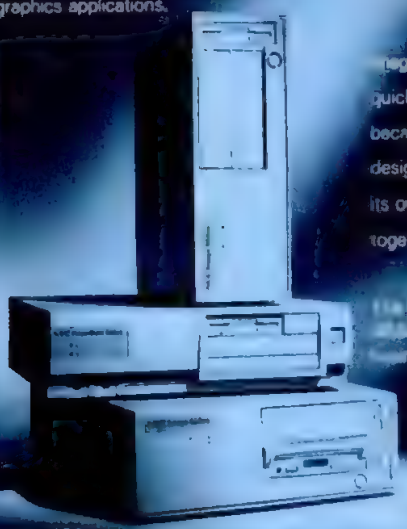

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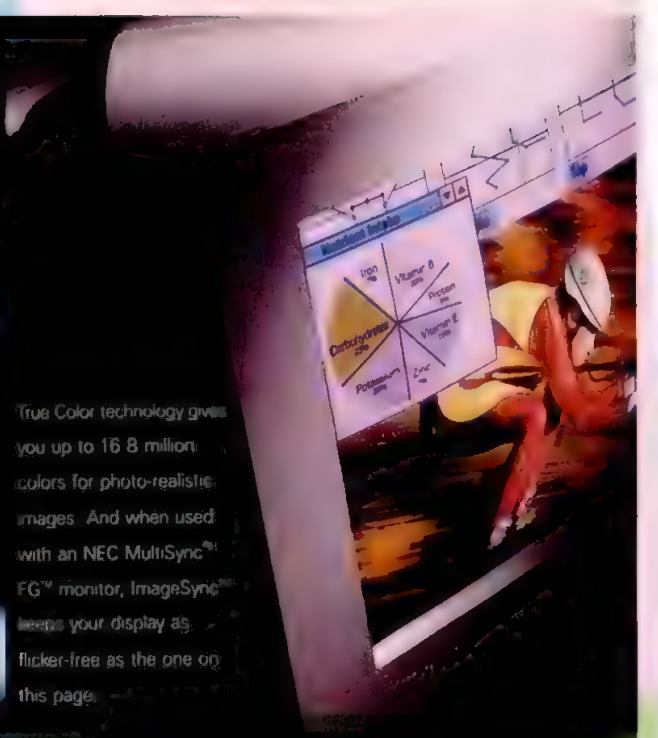

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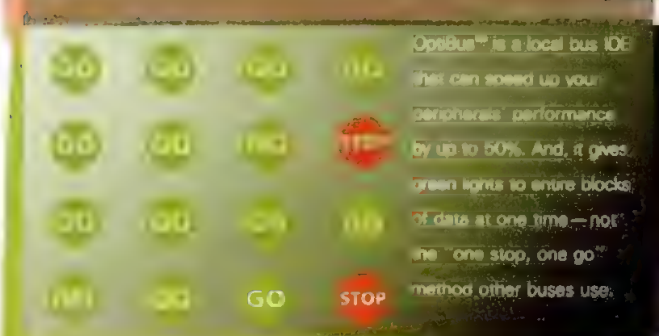

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ant of Unix) is already available for the PowerPC; a PowerPC-specific version of System 7 is scheduled to ship in April; ports of Microsoft Windows NT and Solaris are underway; and Novell is working with PowerPC vendors to provide NetWare support on both the client and server sides. In the future, PowerPC will support three new operating environments: PowerOpen, Workplace OS, and the long-anticipated Taligent.

Conspicuously absent from the list of supported operating systems is the most ubiquitous: DOS, with or without Windows. Neither DOS nor Windows will run directly on PowerPC hardware, but the capabilities of both will be available as subsets of other operating systems or through third-party mechanisms.

The final piece of the puzzle, compelling software applications, is the most critical. But it's also the least clear: Who knows what the "killer app" for PowerPC might be? IBM's Power Personal Systems division is focusing its efforts on "human-centered" interfaces, an ambitious effort to redesign fundamental paradigms for interacting with software. At Fall Comdex, IBM demonstrated an early implementation of its vision: The Conversational Surrogate, an on-screen talking head that accepted spoken commands, performed requested actions, and provided verbal feedback. Though this early attempt was gimmicky—and eerie—it offered a glimpse of one way that PowerPC might step beyond Intel rather than playing catch-up. IBM's eventual goal is a so-called intelligent agent that will automate administrative drudgery by adapting to individual work habits.

A COMPLICATED PICTURE

Should you consider a PowerPC-based machine as your next purchase? It depends on what kind of platform you're looking for. If you're planning to buy a Mac, the answer is an unqualified yes: PowerPC-based Macs will offer previously unattainable levels of performance at affordable prices. If you're in the market for an engineering workstation, PowerPC also looks promising. Most PC users, though, will want to adopt a wait-and-see stance; too many elements remain uncertain to recommend a PowerPC-based machine today.

THE APPLE AGENDA

For Apple, PowerPC represents an all-out effort to approach parity with PC compatibles. Apple has exhausted the performance potential of the Motorola 68000 family and, as we saw last year in our platforms story ("The New PCs," June 15, 1993), the Mac is uncompetitive with high-end Intel-based PCs.

Apple's first PowerPC-based systems will be available by the end of the first half of this year; in about two years, all new Macs—from desktops to laptops to servers—will be based on PowerPC processors. Apple says most 680*x*0 Mac users will be able to upgrade their machines to support PowerPC too; specific upgrade options vary by machine. During the transition, Apple promises not to orphan the 10 million or so 680*x*0-based Mac users, though.

The first generation of PowerPC-based Macs will continue to use the company's NuBus expansion bus, but Apple plans to switch to the PCI (Peripheral Component Interconnect) standard for its second generation of machines.

Macs based on PowerPC processors should feel no different to users, since Apple has ported key components of the Macintosh operating system to the PowerPC. Existing Mac applications will run through emulation integral to the operating system. Apple estimates that early systems will run 680*x*0-specific applications at about the same clip as current 68040-based systems. And performance will only improve as Apple optimizes more of its low-level system code for PowerPC machines.

Additionally, Apple has demonstrated success in convincing software vendors—including Adobe Systems, Claris Corp., and Microsoft Corp.—to port their Mac applications to native PowerPC code. This shouldn't come as a surprise; vendors who don't port will be caught at a competitive disadvantage as PowerPC takes over from the 680*x*0-family machines. A variety of tools to assist in the porting task are already available, and many software vendors are reporting that code written in high-level languages has been easy to convert.

Unix users interested in using PowerPC-based Macs as a platform will have PowerOpen, an operating system based on Unix. An optional Macintosh Application Services (MAS) layer will give PowerOpen the ability to run the Macintosh System and applications in an X window.

POWERPC WORKSTATIONS

IBM's Advanced Workstations & Systems division is already using PowerPC in its newest RS/6000 workstations. The new models are fully backward-compatible with the POWER (Performance Optimization With Enhanced RISC) architecture of their predecessors.

The only PowerPC-based machine shipping in time for our testing was IBM's RS/6000 POWERstation 250, based on the PPC601. Our $11,620 review unit included a 1GB hard disk,

The first commercially available PowerPC system, IBM's RS/6000 POWERstation 250, turned in impressive performance results.

FEATURES PLUS

From February 14 through February 18, you can go on-line to discuss PowerPC's features and future with key executives responsible for its development. Type GO ZNT:EXEC from any CompuServe prompt.

Our Contributors: JOHN CLYMAN is a staff editor of *PC Magazine*, and NICK STAM is the technical director for hardware at PC Magazine Labs. LEON ERLANGER was the associate editor in charge of this story, and MICHAEL J. ZULICH was the project leader.

Software: *You* Can *Take It with You*

by John Clyman

Would you migrate to an unproven new platform—no matter how powerful—if you couldn't take any of your favorite software along? Apple, IBM, and Motorola aren't naive enough to hope so. Instead, the companies are backing emulation and translation capabilities that will let PowerPC machines run most DOS, Macintosh, and Windows applications. That's an important safety net for early PowerPC adopters, since only a handful of native apps will be available anytime soon.

PowerPC's multiple roles—inside workstations, powering new Macintoshes, and competing with Intel-based PCs—mandate multiple approaches to emulation. Microsoft's PowerPC version of Windows NT will include support for existing DOS and Windows applications. Insignia Solutions' SoftWindows will run DOS and Windows programs on PowerPC-based Macintosh and Unix systems. Wabi, from SunSelect—a business unit of workstation maker Sun Microsystems—supports Windows applications on top of Unix. And Apple's version of System 7 for the PowerPC will integrate transparent support for existing 680*x*0-based Macintosh programs.

Buying a PowerPC system just to run under emulation doesn't make sense. But if you intend to jump on the PowerPC bandwagon for other reasons, at least you won't have to bid adieu to the software you've got.

INSIGNIA'S SOLUTION

Most *x*86-specific programs on PowerPC machines will run under Insignia's SoftWindows for PowerPC emulator. (Versions for both Macintosh and RS/6000 systems will be available early this year.) Insignia developed the *x*86 code compatibility that ships as part of Windows NT for the Alpha (from Digital Equipment Corp.) and MIPS R4000 platforms. Thanks to a licensing agreement with Microsoft, Insignia has access to complete Windows 3.1 source code.

As a program runs, SoftWindows examines each *x*86 instruction and translates it into an equivalent PowerPC instruction (or series of them). When the program calls a Windows function, though, this time-consuming emulation is unnecessary, since Insignia has recompiled Windows itself into native PowerPC code. Insignia estimates that SoftWindows on a low-end PowerPC system will perform at the level of a 486SX/25-based PC.

SoftWindows, which can run either in a window or full-screen, looks and feels just like a "real" Intel-based PC running DOS and Windows. SoftWindows lets you interact with the native operating system too; under Apple's System 7, for instance, you can cut text from a Windows program and paste it directly into a Macintosh application.

Right now, SoftWindows only emulates a 286. That limits Windows to real and standard modes, so you can't use some of its multitasking features or virtual-memory capability. And applications that require a 386 (such as AutoCAD or FrameMaker) will not run at all. Later this year, SoftWindows will be upgraded to emulate a 486 processor.

SoftWindows needs 6MB to 8MB of RAM to emulate a 2MB DOS machine; 12MB to 16MB is necessary to run Windows effectively, according to Insignia. Final pricing was not available, but a company spokesman estimated a $499 price tag.

WABI: FAST BUT LIMITED

SunSelect's Wabi lets PowerPC systems run Windows software through translation. Wabi will appeal primarily to workstation users who want to run a handful of productivity applications on top of Unix.

Wabi intercepts calls to Windows functions and converts them into equivalent X Window and Unix functions. (X Window is a graphical interface that runs on top of various flavors of Unix.) Imagine a Windows program calling a standard routine to display a dialog box; rather than providing code that actually draws the box, Wabi reroutes the request to equivalent X Window routines. Individual program instructions are handled with a built-in *x*86 emulator.

The key advantage of translation over emulation is speed. IBM estimates that early PowerPC machines will run *x*86 applications under Wabi at as much as twice the speed of a 486DX2/66-based unit.

Wabi makes no pretense of supporting DOS programs, and Windows programs that eschew standard Windows programming practices may also cause problems. Late last year, SunSelect had formally certified 13 major Windows applications with Wabi and claimed to be running more than 50 successfully in its labs.

The first version of Wabi supports only PostScript printers and will not work with programs that rely on multimedia extensions to Windows. But for many Unix users, the capabilities it provides will suffice.

APPLE: EFFORTLESS COMPATIBILITY

Since Apple plans to equip all new Macintosh systems with PowerPC CPUs within two years, its commitment to backward compatibility for 680*x*0-based software is strong. Most Mac applications will run unmodified under the PowerPC release of System 7.

Apple is porting critical pieces of its operating system and low-level Toolbox routines to native PowerPC code; Apple estimates that early PowerPC systems will run 680*x*0 programs at the speed of today's Macintosh systems. Applications written specifically for PowerPC machines will run faster. □

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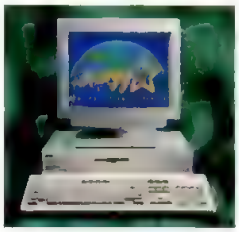

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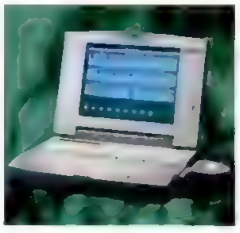

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32MB of RAM, an ultrafast graphics accelerator, and AIX. We had Workstation Laboratories of Humboldt, Arizona, a recognized leader in Unix testing, put the machine through its paces. The findings: The RS/6000 Model 250's performance was exceptional, superior to many workstations costing thousands of dollars more. It achieved an integer SPECmark score of 62.6 and a floating-point SPECmark score of 72.2—roughly comparable with Intel's claimed performance for the Pentium. Floating-point computation has always been a strength of the RS/6000 line, and IBM's new systems appear to maintain that tradition. (For further details, see the First Looks section of *PC Magazine*, February 8, 1994.)

Other workstation manufacturers have announced plans to use PowerPC, including Groupe Bull (parent of Zenith Data Systems), Harris Semiconductor, and Tadpole Technology. All of these companies plan to market engineering workstations based on PowerPC processors running various flavors of Unix, including PowerOpen. Tadpole has even worked with IBM to develop a Unix-capable PowerPC portable.

RISC Contenders on the Desktop

by John Clyman

PowerPC is hardly the first RISC processor family to challenge Intel's dominance on the desktop. Two of the best-known are Digital Equipment Corp.'s Alpha and MIPS R4000 families. Other contenders include Sun Microsystems' SPARC and Hewlett-Packard Co.'s PA-RISC families.

Traditionally, these RISC processors have been confined to Unix workstations. With the debut of Microsoft Windows NT, though, they stand a chance of entering the mainstream. The accompanying table describes some of the key features that differentiate these CPU families, with Intel's Pentium included for comparison. (Processors listed in the table represent the current high end of their respective lines.)

SPEED DEMONS

The Alpha 21064, which is available today at speeds of up to 200 MHz, attests to the performance potential of RISC. The 21064 can execute up to two instructions per clock cycle, though only one of these two can be an integer instruction.

Alpha chips employ a full 64-bit design that lacks a 32-bit subset; they perform all computations on 64 bits at a time. While the PowerPC architecture provides a 64-bit option, to be implemented in the PowerPC 620, early PowerPC processors will operate on more-traditional 32-bit chunks. Alpha-based PCs are available from Digital and from some smaller vendors, including Carrera Computers and DeskStation Technology.

The MIPS R4000 line, which includes the low-power MIPS R4200 and high-performance MIPS R4400, is designed by MIPS Technologies and manufactured by other companies such as NEC Electronics and Toshiba America Electronic Components. The current performance leader in the MIPS R4000 family, the MIPS R4400, is not a superscalar processor; it can execute only a single instruction per clock cycle. Its maximum clock speed is 150 MHz.

MIPS processors offer two significant strengths. One is a wide range of price points, with corresponding computing power. The other derives from the company's close association with Microsoft Corp. While most CPU manufacturers must port Windows NT themselves, Microsoft itself is responsible for the MIPS implementation of Windows NT. In fact, Microsoft initially developed Windows NT on MIPS-based systems. MIPS-based systems are available from Acer America Corp. and NEC Technologies, among other vendors.

Windows NT is not available for Sun's SPARC line today, although a port is currently underway. Hewlett-Packard Co. has not formally announced plans for Windows NT, but a port for its new PA-RISC 7100LC processors is expected. □

High-Performance Microprocessors: An Overview

■ = YES □ = NO

	Designer	Microsoft Windows NT currently available	Maximum clock speed	Price per chip	Register size	Operating voltage	Typical power consumption at maximum clock speed	Maximum number of instructions per cycle	Cache size
Alpha 21064	Digital Equipment Corp.	■	200 MHz	$1,304 ❶	64-bit	3.3V	27W	2	16K (8K for code 8K for data)
MIPS R4400	MIPS Technologies Inc	■	150 MHz	$450–$600 ❶	64-bit	3.3V, 5V	10W (3.3V), 20W (5V)	1	32K (16K for code, 16K for data)
PA-RISC 7100	Hewlett-Packard Co.	□	99 MHz	Info not available	32-bit	5V	23W	2	N/A
Pentium	Intel Corp.	■	66 MHz	$898 ❷	32-bit	5V	13W	2	16K (8K for code, 8K for data)
PowerPC 601	Apple Computer Inc., IBM Corp., Motorola Inc.	□	80 MHz	$545 ❶	32-bit	3.6V	9W	3	32K (unified)
Sun SuperSPARC+	Sun Microsystems Inc	□	50 MHz	$860 ❷	32-bit	5V	9.5W	4	36K (20K for code, 16K for data)

❶ In lots of 1,000. ❷ In lots of 10,000. N/A—Not applicable: The product has no on-board cache.

PC BUYERS: WAIT AND SEE

For most mainstream PC buyers (and most of *PC Magazine*'s readers), PowerPC is still an iffy proposition. At the time of this writing, no PowerPC-based machines that could be classified as PC-like were available. Also, elements of the operating-system and software puzzles are still missing. Even when all the pieces are eventually in place, it may not be immediately clear where PowerPC is headed.

Should you consider a PowerPC-based machine as your next purchase? It depends on what kind of platform you are looking for.

Once the various elements of PowerPC begin to coalesce, you should think about PowerPC just like any other high-end desktop system. The users who should consider PowerPC systems as an option tomorrow are the same power users who would buy a Pentium machine (or perhaps a MIPS or an Alpha system to run Windows NT) today.

Among the operating system these users might run, Windows NT or Workplace OS are the two most likely. AIX, PowerOpen, and Solaris have appeal to workstation users but few others. The successor to Windows 3.1, currently known as "Chicago," will probably not be available on PowerPC systems, because it is so closely tied to *x*86 hardware.

We expect Windows NT will command the strongest following among buyers of Power Personal Systems machines, largely because of its apparent similarity to Windows 3.1. Workplace OS will support a variety of operating-system "personalities," including OS/2, DOS and Windows, and Taligent (which will not be shipping for at least another year). Because of its novelty, though, it will probably prove most appealing to existing users of OS/2.

UNDER THE HOOD

Although we had no PowerPC-based machines to examine (aside from an IBM workstation), we can deduce, based on conversations with IBM, much of what the first mass-market PowerPC systems will look like under the hood. We expect, for example, that virtually all PowerPC machines will use a PCI bus for peripheral expansion, probably tied to an ISA bus for low-speed peripherals. Expansion cards that work on Intel-based PCI machines should also function in PowerPC systems; only the device drivers that allow them to communicate with the operating systems need differ. Peripheral and support-circuitry manufacturers including Cirrus Logic, NCR Corp., and Western Digital Corp. have pledged support for PowerPC.

IBM's Power Personal Systems division plans to have a variety of PowerPC-based machines available in the second half of this year. These machines will incorporate CD-ROM drives, stereo audio capabilities, and ISA expansion-bus support. PCMCIA slots will be pro-

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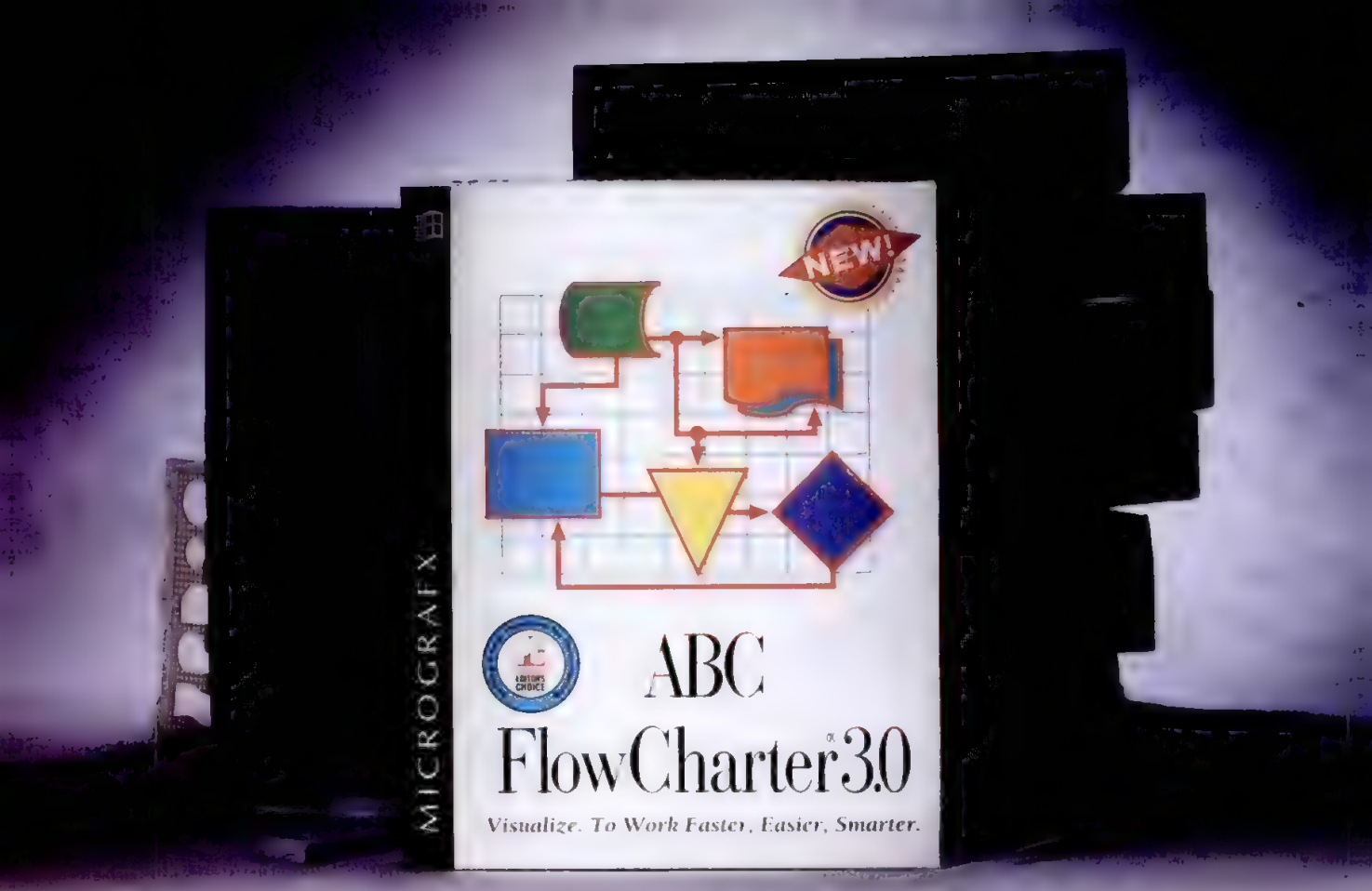

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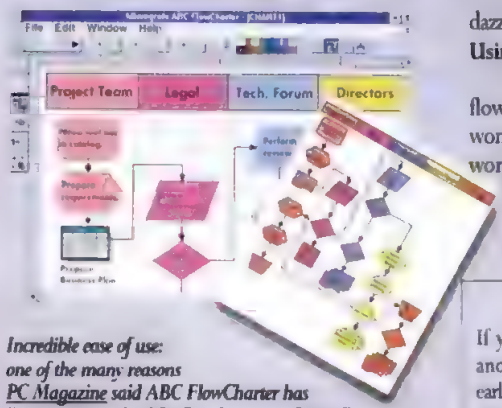

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vided even on desktop systems, and energy conservation will be stressed.

The key differences between PowerPCs and Intel-based systems will lie closer to the processor. While 486 and Pentium systems are generally equipped with secondary (L2) caches ranging from 64K to 256K, most PowerPC machines will have none; the chip's larger cache and reduced memory accesses make secondary cache less necessary. The core logic that ties the CPU to memory and to an expansion bus will also necessarily differ from that on an Intel-based machine. Since this logic is usually contained on just one or two chips, though, this should present only a minimal obstacle to system designers. IBM is already producing PowerPC PCI chip sets, and NCR will begin later this year.

Additionally, PowerPC processors should sidestep two problems that have plagued high-end Intel-based PCs: bus clock frequency and heat dissipation. The Pentium drives its external interface at the same 60- or 66-MHz speed as it operates internally; designing a memory subsystem that can handle such high frequencies is nontrivial. PowerPC chips contain variable clock multipliers on-board, so they can operate at disparate frequencies internally and externally—much like Intel's clock-doubling 486DX2 processors, except that they are not limited to merely doubling the clock frequency. PowerPC processors, because of their low-voltage design and lower transistor counts, also run cooler than the Pentium does in its current incarnation.

STAY TUNED

Motorola and IBM will likely sell over a million PowerPC processors this year into the Mac and IBM workstation markets—quite an accomplishment in itself. But for mainstream PC buyers, it's hard to find a compelling reason to abandon the Intel architecture, especially since PowerPC systems and software have yet to materialize. Even those million units are a drop in the bucket compared with the tens of millions of CPUs Intel will sell this year.

Still, if any RISC family can challenge Intel head-on, PowerPC is the one. It's a solid architecture, and it's backed by three companies with deep pockets and—so it seems—deep resolve. Major 32-bit operating systems are supported, and legacy software is adequately handled. If Mac software developers can leverage PowerPC's performance to offer capabilities beyond the reach of Intel-based machines, manufacturers of PC compatibles may flock to PowerPC.

Even if PowerPC does not become a rousing success, it will likely have a welcome effect on the market. Pressure from a serious competitor should keep Intel busy pushing the performance envelope, which benefits us all.

At this point, it's difficult to predict PowerPC's future with any accuracy. Too many elements are still in flux. But stay tuned: We'll be looking at PowerPC systems again in a few months, comparing them directly against Pentium machines and other RISC platforms to help you decide which is right for you.

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Looking Inside The PowerPC 601

by Nick Stam

Compared with many other RISC chips, the PowerPC 601 runs at relatively low clock speeds, possibly because it's more complex than many RISC processors. But in general, the 32-bit PPC601 is a strong first implementation of a forward-looking, technically impressive architecture. (We use IBM Corp.'s "PPC" model-number prefix for consistency; Motorola's model numbers for PowerPC processors begin with "MPC.")

The PPC601, jointly designed by Apple Computer, IBM, and Motorola at their Somerset facility in Austin, Texas, employs a number of classic RISC design techniques and adds clever performance-enhancing tricks such as out-of-order instruction dispatch, branch folding, memory-operation queuing, and block address translations.

A central component of RISC processors is a large register set, which lets programs store many variables on-chip. This reduces memory accesses (lowering delays interfacing with system RAM) as well as on-board cache references; the downside is added decode time and chip real estate.

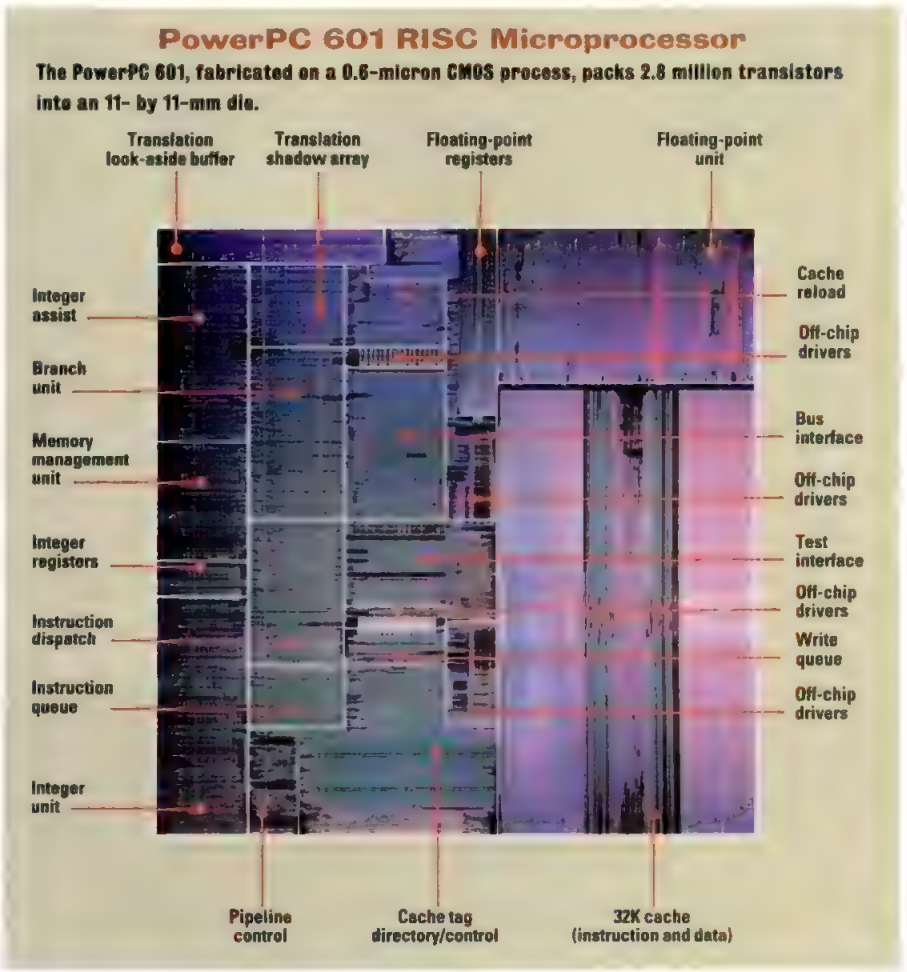
The PPC601—and all announced PowerPC implementations with the exception of the PowerPC 620—provides 32 32-bit general-purpose registers (GPRs) and 32 64-bit floating-point registers (FPRs). The forthcoming PPC620, a fully-64-bit CPU, will use 32 64-bit GPRs.

This number of registers is about typical for RISC processors; by contrast, Intel's CISC CPUs offer only eight GPRs and eight FPRs. At the other extreme, Advanced Micro Devices' 290*x*0 RISC processors contain 192 registers.

INSTRUCTION SET

The PPC601 uses consistently formatted 32-bit instructions to permit efficient fetching and decoding. The PowerPC architecture defines more than 220 distinct instructions, enough to make PowerPC seem—at first glance—more like CISC than RISC. Particular instructions such as Branch and Link, Load Multiple, Store Multiple, Load String, and Store String are strongly reminiscent of IBM CISC mainframes. Instructions like these, which are unusual for a RISC processor, exist because one of IBM's design goals for the PowerPC was to reduce path length (the number of instructions in a program). The rationale is that a single relatively complex instruction can perform operations that would otherwise require a series of simpler instructions. Interestingly, Motorola predicts that such complex instructions may create processing bottlenecks in future PowerPC chips and suggests that programmers avoid them entirely.

In most other ways, though, the PowerPC adheres to traditional RISC design philosophies. Like most RISC processors, the PowerPC strives for short clock cycle times (fast clock speeds) and reduced clocks per instruction. And the PowerPC employs the "load/store" archi-



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tecture typical of RISC processors, meaning that nearly all PowerPC instructions operate on values stored in registers; memory accesses require explicit load and store instructions.

With the exception of a few instructions that are trapped and emulated in software for compatibility with IBM's POWER (Performance Optimization With Enhanced RISC) architecture, PowerPC instructions are all hardwired. Most CISC chips, on the other hand, handle complex instructions in microcode (low-level programs that execute inside the chip). Microcode reduces performance and requires more decoding logic and chip surface area.

PIPELINED AND SUPERSCALAR DESIGN

A key component of RISC design—one also employed by many modern CISC processors—is pipelining. Pipelined microprocessors divide up the processing of an instruction much like an assembly line; as one stage is completed, an instruction moves down the pipeline and the following instruction moves into that stage.

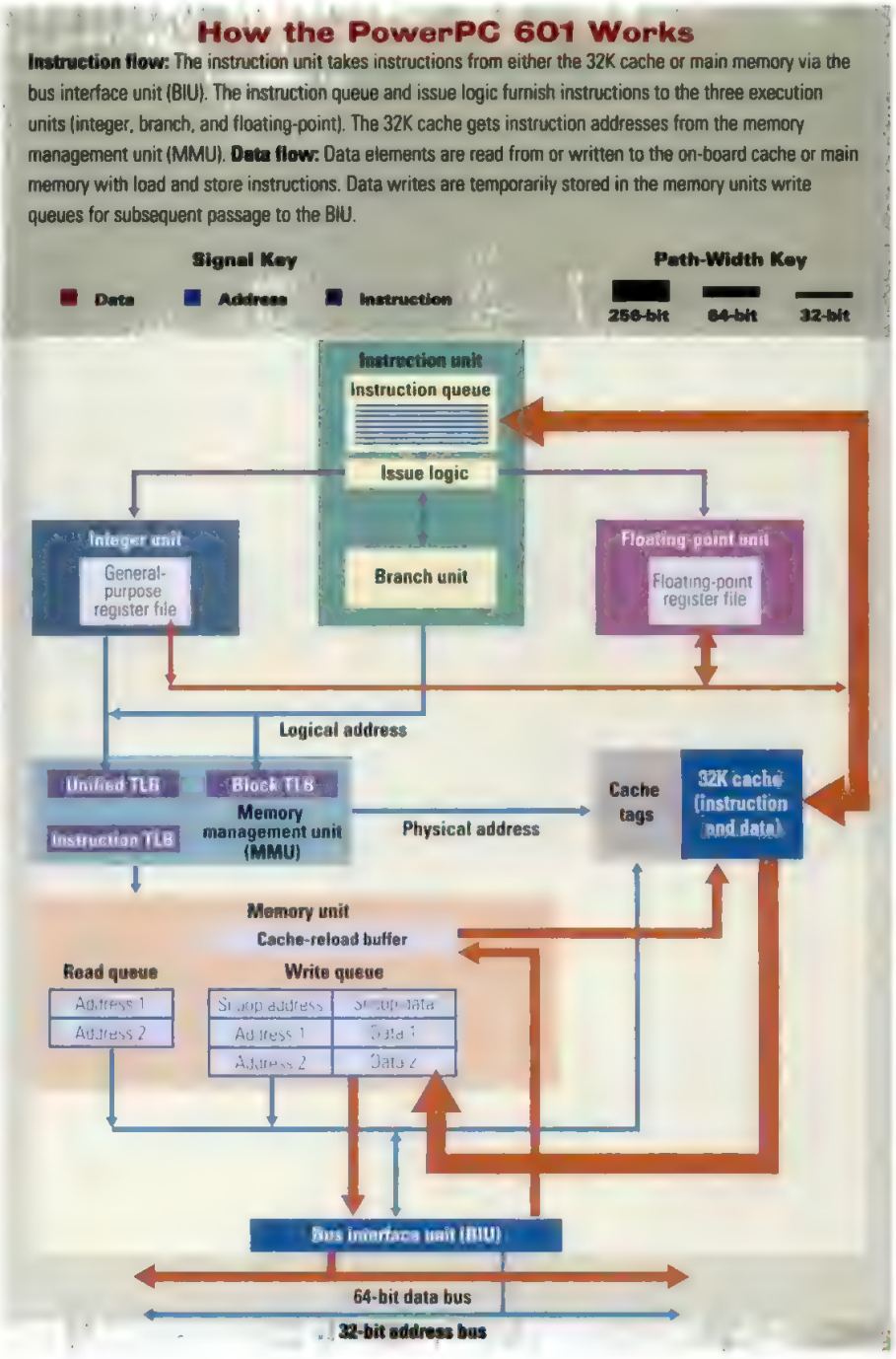
Typical processor pipelines include four stages, called instruction fetch, instruction decode, execute, and write-back. Variations on this theme exist, too; many processors dedicate additional stages to subfunctions within each of the basic stages.

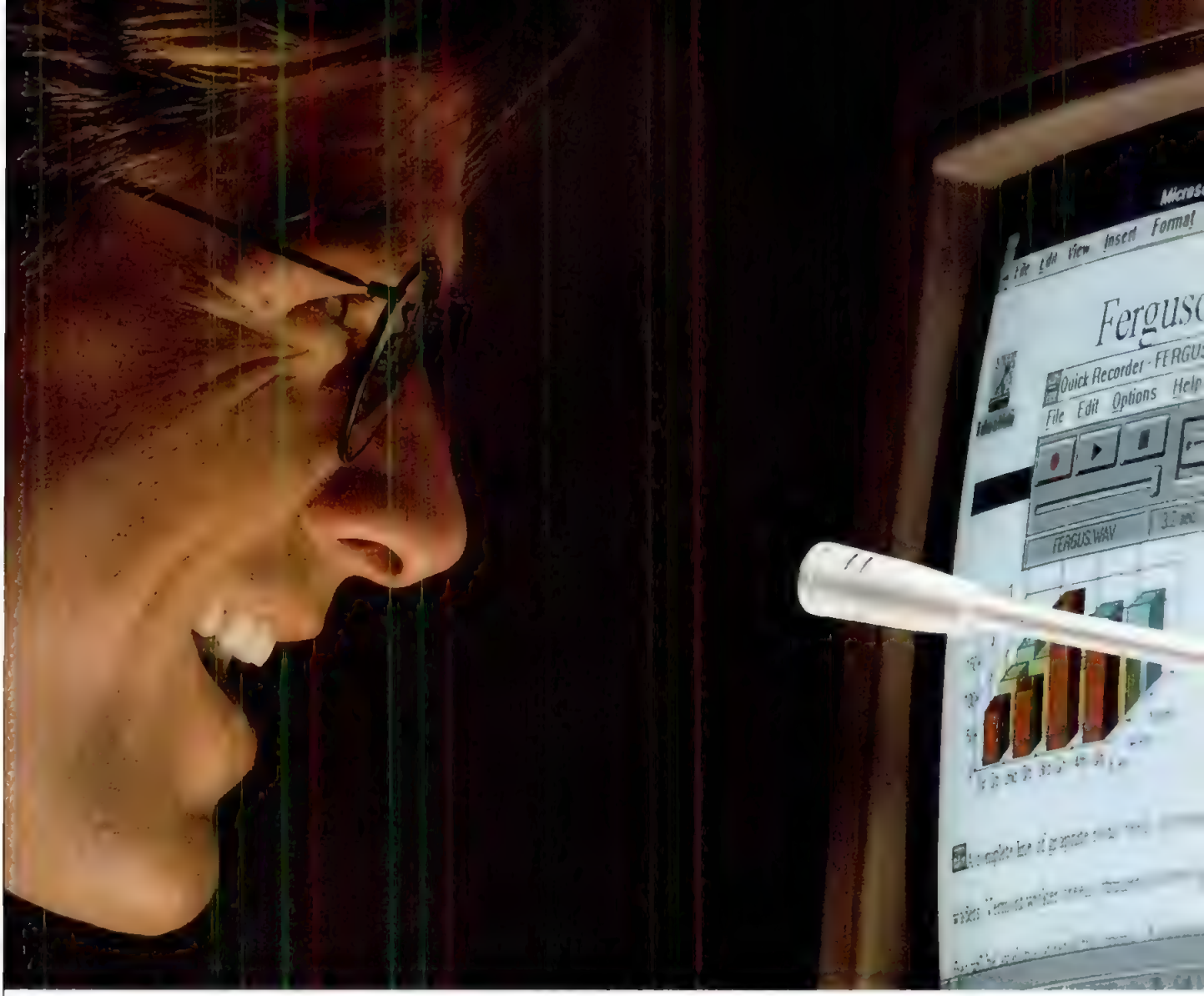
A processor with a single pipeline is a scalar processor; microprocessors with multiple pipelines are called superscalar. Additional pipelines generally improve performance—but not in a linear fashion, because conflicts for resources frequently arise. These pipeline hazards and pipeline stalls force the processor to freeze one or more pipelines until shared resources are available.

The PPC601 can issue up to three instructions at a time to three independent, pipelined execution units: the integer unit (IU), branch unit (BU), and floating-point unit (FPU). A separate instruction unit manages the flow of instructions to the execution units. The instruction unit fetches instructions from on-board cache memory via a 256-bit interface, stores them in an instruction queue, and dispatches them to the execution units.

The PPC601 does not push the limits of superscalar design and performance. Intel's Pentium processor includes two separate integer pipelines, a more effective design for running typical applications heavy on integer processing. One of the Pentium's two pipelines, however, is limited to executing "simple" hardwired instructions, primarily arithmetic and logic operations. Organizing instructions to use this restricted dual-pipeline architecture optimally while avoiding resource conflicts requires special compiler techniques.

To derive maximum benefit from its single-integer pipeline, the PPC601 employs a data-forwarding feature that lets it rapidly deliver results of register updates to subsequent instructions that also use the same register. After an instruction modifies a register in the execute stage, the results can be passed concurrently to the next instruction and to the register file. This technique helps minimize delays introduced by register





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dependencies.

Second-generation PowerPC chips—the PowerPC 604 and PPC620—will implement at least two integer pipes. As an interim step, the PowerPC 603 splits its single integer unit into three independent functional units—a load/store unit, a fixed-point unit, and a system unit.

To feed its pipelines most efficiently and gain the greatest benefit from its superscalar design, the PPC601 reorders instructions slightly—a technique known as out-of-order execution. The PPC601's instruction queue (or "instruction window") can hold eight instructions. Instructions headed for either the branch or floating-point units may be issued from any of the first four positions. Instructions destined for the integer unit must reside in the first (bottommost) entry in the queue. After instructions have completed the execute stage of their respective pipelines, their results are collated.

FLOATING-POINT UNIT

The PPC601's FPU is IEEE-754–compliant and supports both single- and double-precision operations. Because of the complexity of floating-point instructions, the FPU's pipeline requires two (rather than one) execute stages. The FPU houses two additional instruction queues to buffer issued FP instructions which helps relieve instruction-issue bottlenecks from the main instruction queue.

The PPC601's FPU supports an unusual compound multiply-add function, which should enable it to handle digital-signal-processing–like algorithms efficiently.

The PowerPC 601 processor can issue up to three instructions at a time to three independent, pipelined execution units.

BRANCH PREDICTION

The PPC601's branch-prediction capabilities, which enable the CPU to guess how program flow will change, help it avoid delays associated with many program branches. When the PPC601 predicts a branch correctly, it can perform the branch in zero cycles—that is, instantaneously. An incorrect prediction, however, can cause substantial delay; instructions that have already entered the pipeline and instructions in the prefetch queue must be flushed, and new instructions must then be loaded and fed back into the first stage of the pipeline.

In most applications, about one in seven instructions is a branch. Unconditional branches—those that are always taken—are easiest for the PPC601 to resolve. The branch unit simply tells the instruction unit to begin fetching instructions from the branch target address, a technique known as branch folding. The branch instruction itself is thrown out of the instruction stream, so it takes no time to execute.

Conditional branch instructions require more logic to handle, because whether or not they are taken depends on the result of a comparison. (A conditional branch instruction is analogous to an if-then statement.)

A given conditional branch may be either resolved or unresolved at dispatch time, depending on whether the CPU can be sure beforehand whether the branch will be taken. If the branch is resolved, the CPU handles it much like an unconditional branch.

For unresolved conditional branches, the PPC601 relies on a static branch-prediction technique. Normally, any branch that would force the program to jump backwards is assumed to be taken. Branches that jump forward are assumed not to be taken. This approach is sensible; the branches at the end of loops—which are taken about 90 percent of the time—are usually backwards. A compiler, however, can override this default response if it expects a program to defy typical behavior.

Intel's Pentium uses a more effective dynamic branch-prediction system; its branch target buffer retains historical branching behavior of the 256 most recently encountered branch instructions.

After resolving the branch or making its best guess, the PPC601 branch unit

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directs the instruction unit to begin fetching from the predicted target address. These instructions are only partially executed until the result of the branch is known; registers and memory are updated only after it is certain that the branch was correctly predicted.

CACHE AND MEMORY UNITS

The PPC601 implements a 32K unified on-chip cache, which is shared by both instructions and data. Many other processors, including the PPC603 and the Pentium, use a split design for their on-chip cache.

A unified cache allows dynamic allocation of cache space either to instructions or to data. But when both instruction fetches and data accesses occur simultaneously at different pipeline stages, bottlenecks occur. Separate caches eliminate instruction and data-access conflicts but forgo efficiencies gained by dynamic resizing.

The PPC601's cache employs an eight-way set-associative design; each set contains 64 lines of 64 bytes. Each line is further divded into two 32-byte sectors (each 256 bits, or 8 words), and all cache load and write-back operations are performed at this sector size.

As with most cache designs, a least recently used (LRU) algorithm governs cache sector replacement. The PPC601's cache uses a write-back policy by default but can be set to write-through on a per-page or per-block basis.

The MESI protocol and a port dedicated to bus snooping help ensure cache and main-memory coherency in multiprocessor systems.

Multiprocessor support is provided via the MESI (modified, exclusive, shared, invalid) cache-coherency protocol. A separate port for cache tag directory access is also dedicated to bus-snooping operations. This helps ensure cache and main-memory coherency in multiprocessor systems.

A memory unit between the cache and the bus interface unit queues pending memory operations, so the cache can deliver data and instructions to the execution units without waiting for slow external memory to catch up. The memory unit uses a two-element read queue and three-element write queue; one of the write-queue elements is dedicated to servicing snoop-driven write-backs. Read operations are sometimes allowed to bypass queued writes to improve performance.

MEMORY MANAGEMENT UNIT

The PPC601's memory management unit (MMU) supports demand-paged virtual memory operating systems by performing virtual-to-real address translations and enforcing memory protection and access privileges. The PPC601 supports up to 4GB of physical memory, and the chip's MMU supports an enormous 4-petabyte virtual address space (compared with the Pentium's quite adequate 64 ter-

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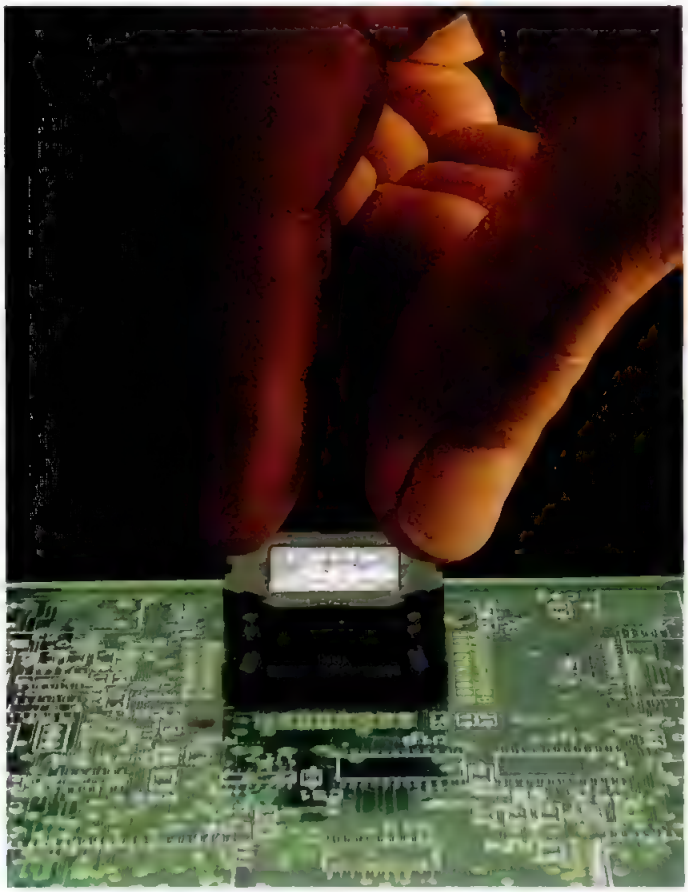

abytes). The PPC601's address space can be divided into many 256MB regions called segments, 128K-to-8MB areas called blocks, or both. Segments can be further broken down into 4K pages—the basic units that are swapped out to disk to enable virtual memory.

The MMU handles address translations at the segment, page, and block levels. Block address translations are particularly useful for handling large, linear graphics frame buffers because they significantly reduce TLB (translation lookaside buffer) thrashing.

The MMU uses three TLBs. The ITLB (instruction TLB) holds the four most recent block or page translations for instruction addresses. The UTLB (unified TLB) holds 256 recently used page translations for instructions and data and acts as a backup for ITLB misses. The BTLB (block TLB) holds four recent block address translations using special BAT (block address translation) registers to generate physical addresses.

If an address translation is cached in the UTLB and BTLB simultaneously, the BTLB takes precedence. The ITLB is accessed independently by the instruction unit, so other processing units can concurrently access the UTLB and BTLB for data translations. A miss on all three TLBs initiates a hardware lookup on a hashed page table stored in RAM.

The PowerPC architecture supports two privilege modes: supervisor mode, typically used by the operating environment, and user mode, used by application programs.

EXTERNAL-BUS INTERFACE

The PPC601's bus interface unit (BIU) is based on the Motorola 88110 RISC chip's bus unit. The BIU includes a 64-bit data bus, 32-bit address bus, and control signals. All data and address transfers are parity-checked.

The most common PPC601 bus transactions are burst-read and burst-write operations to transfer data to and from the on-chip cache. Burst operations can transmit 256 bits—one full cache sector—at a time. Nonburst operations transfer between one and eight bytes as needed.

The BIU can process two bus cycles simultaneously using a feature called address pipelining. This helps system designers speed accesses to slow DRAM. The BIU also supports multiprocessor configurations through snooping operations, data- and address-bus arbitration signals, and external control of internal cache and TLBs.

The PPC601 is intrinsically a *big-endian* processor, meaning that it makes a particular assumption about the ordering of multiple-byte values in memory. Most other processors are big-endian as well; the notable exceptions are Intel's *x*86 CPUs, which are *little-endian*. The PPC601 can switch into a little-endian operating mode on the fly if the processor needs to support *x*86-ordered data directly.

There's far more of interest inside the PPC601 than we have space to discuss here. Among other things, hardware debug and chip-testing capabilities are built into the chip, as is a read-only processor version register that identifies the CPU's model and revision level. □

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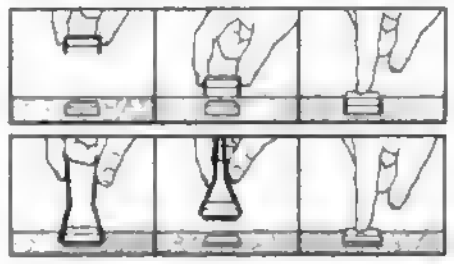
Performance Benchmarks		
(figures indicate relative performance)	Intel i386	Cyrix 486 Upgrade
MS Excel 3.0	1.0x	2.1x
MS Word 2.0	1.0x	2.8x
Micrografx Designer 3.1	1.0x	2.6x
Benchmark tests run on IBM PS/2 Model 70 20MHz		

What kind of performance boost will you get? Depends on the 386 model you have, and your applications. But tests show performance ranges from 30% to well over 100%. As the lawyers say, your actual mileage may vary.



On DX versions, use the chip removal tool (included) to take out the existing chip, and plug in the Cyrix Upgrade Microprocessor. On an SX, just snap into place right over the existing chip. All in all, it takes just 15 minutes—roughly the same amount of time as a coffee break.

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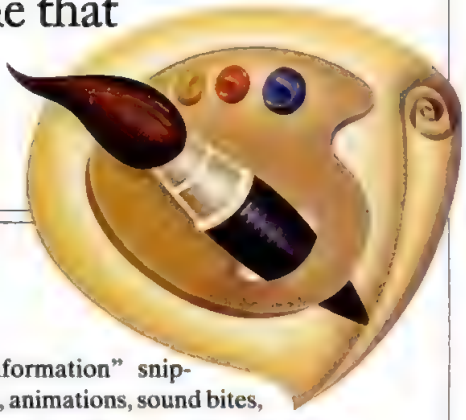
Creating Multimedia *To Die For*

The fruits of multimedia labor are everywhere. We look at five authoring packages and determine that multimedia creation is easier than ever, but it's still not for the faint of heart.



by Robin Raskin

There's a joke in the industry that asks, "How do you turn a $3,000 PC into a $300 TV?" The answer, of course, is with multimedia. Combining graphics, sound, text, animation, and video into a single, codified presentation is becoming more and more a part of mainstream computing. From commercial software titles to training materials to shopping-mall kiosks to office presentations, multimedia is popping up everywhere. And that, of course, means an increase in the use of multimedia creation tools.

Authoring systems (a pretty bad term for a pretty good thing) allow multimedia creators to string together the disparate parts of their creations. Like a cook assembling ingredients, the multimedia author builds up a collection of "information" snippets—text, drawings, animations, sound bites, and videos—and assembles them into a coherent product.

Although multimedia authoring systems integrate elements created in other software packages, they typically provide their own sets of tools. We look at five authoring packages in this roundup—Authorware Professional for Windows, Version 2.0.1; IconAuthor for Windows, Version 5.0; Multimedia ToolBook, Version 1.53a; TIE Authoring System for Windows, Version 4.0; and TourGuide for Windows, Version 1.3—all of which have rudimentary tools for text and graphics creation and some way of handling animations.

The most compelling part of multimedia is that it's more

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Illustration by Dan Picasso

Suitability to Task: Multimedia Authoring Software

While all five packages in this roundup are designed to help create professional multimedia applications, the methods they use are quite different. As a result, some packages fared better at some tasks than others. We rate the packages on the three types of tasks most important for a multimedia professional: kiosk creation, runtime creation, and CBT (computer-based training) creation.

In rating a package's **kiosk creation** abilities, we test each product to evaluate its adaptability to a public-access terminal application. We pay special attention to support for touch-screen areas and hot buttons, full-featured branching, and multimedia integration. To score well, a package also has to support video overlay boards and external devices such as laserdisk players and CD-ROM drives, rather than requiring you to send your own MCI commands. Robust support for importing varied file formats, including graphics, sound, and digital video files and the ability to control these files easily are also important.

To be truly useful for **runtime creation,** a package has to be able to keep track of all your multimedia files, package them, and notify you of lost files. We look at the power of each package's runtime utility as well as the ease with which you can distribute your presentations. We also note if a package requires you to purchase a separate product in order to play a runtime version of a kiosk. Other important factors here are the size and completeness of the compiled application, how portable it truly is, and how well it plays back.

Several issues are involved in rating each package for its usefulness in **CBT (computer-based training) creation.** A package may provide full functionality in this area, but equally important is how it simplifies the CBT designer's task. We test for a system's ability to help you construct a complex interactive program, placing emphasis on conditional branching, program flow, data validation, hypertext functions, and underlying database support. Extra features to enhance ease of use, such as a built-in timer, work in a product's favor, as do a flexible and well-documented scripting language and adequate on-line help.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Kiosk creation	●	●	●	●
Runtime creation	●	●	●	○
CBT creation	●	●	○	○
Runtime creation	●	○	○	○
CBT creation	N/A			

N/A—Not applicable: The product does not perform this task.

than just a linear flow of information: It's a road map for moving through that information. Presentations, computer-based training (CBT), and kiosk applications comprise a majority of multimedia authoring creations. We used these real-world scenarios to test each product.

THE DIFFERENCE

There's no clear point at which desktop presentation tools end and authoring tools begin. Presentation packages such as Lotus Development Corp.'s Freelance Graphics for Windows, Microsoft PowerPoint, and Software Publishing Corp.'s Harvard Graphics for Windows—all of which use a "slide" metaphor—are capable of using multimedia elements in their presentations. Asymetrix Corp.'s Compel and Macromedia's Action! take multimedia a step further by allowing finer control of the synchronization of events (for more information, see "Desktop Presentations: The Sound and the Fury," *PC Magazine,* September 14, 1993).

Multimedia authoring packages, however, accomplish more than presentation packages through variables that can change as the program is run. This allows you to present different information to many types of users and obtain information from users, evaluate it, and respond. All of the programs in this review handle variables with aplomb, though none handled database access particularly well.

Authoring systems also tend to be programmable, use programming constructs, or support calls to external programming languages. Price is another distinction: Desktop presentation software seldom exceeds $495; some packages are under $100. Authoring systems, however, are expensive, with Authorware Professional for Windows and IconAuthor for Windows taking the lead at $4,995.

Perhaps the single most important change from past reviews of multimedia authoring systems is the shift to Microsoft Windows and its maturing MCI (Media Control Interface) level of control. The last time we reviewed this category ("Author! Author!," *PC Magazine,* March 31, 1992), MCI was about to begin shipping with Windows 3.1. DOS-based multimedia authoring tools had to support hardware devices on an individual basis, with each program writing drivers for each device.

The MCI sits between the hardware driver and the operating system as a sort of "Über-driver." Any drivers written to the MCI can be plugged in to any program that uses the MCI API in Windows. In other words, software developers don't have to write a hardware-specific driver. They can write to a more generic MCI layer that in turn defines the standard interface for MIDI audio and devices such as CD players, laserdisks, and VCRs.

TROUBLE AHEAD

While most of these programs provide a way to send MCI command strings, generally they have not yet integrated MCI use into their interfaces. Also, they don't for the most part provide adequate documentation on how to write MCI code; you have to buy the Microsoft Windows Software Development Kit ($150) for examples on how to implement MCI commands.

Another creation problem is that the cost of creating full-screen, full-motion

Our Contributors: ROBIN RASKIN is the editor of *PC Magazine.* JOHN MOORE is a staff editor of *PC Magazine.* LUISA SIMONE is a contributing editor of *PC Magazine.* DON LABRIOLA, PAULINE ORES, and STEPHEN W. PLAIN are frequent contributors to *PC Magazine.* ERICK and LINDA VON SCHWEBER are the principals of Infomaniacs, an Atlanta-based research and production company specializing in new edge technologies including multimedia and virtual reality. GAYLE C. EHRENMAN was the associate editor in charge of this story and JEFF MACE was the project leader.

digital video is still high; users need hefty processing power and storage. JPEG video, one of the highest-quality digital video formats available, still requires expensive hardware assistance. Most video creators today work around the limitation by using Microsoft Video for Windows, which supports a number of video compression/decompression algorithms (codecs) to produce a small screen playback window with limited color resolution at about 15 frames per second. However, we expect that full-screen, 30-frame-per-second video will be available as video compression algorithms improve and hardware acceleration boards get less expensive.

OS/2 2.1 has impressive multimedia power as well. At the time of our review, we found there was excellent support for a limited set of hardware, but only limited support for most hardware. In fact, Ultimedia Builder/2 could not complete our test script using our standard testbed (for more information, see the sidebar "What's OS/2 Got to Do with It").

The five packages reviewed here all import standard sound, graphics, and animations. They all have conditional logic, can drive a laserdisk player, can produce a standalone multimedia presentation, and incorporate some sort of runtime player (license agreements vary). IconAuthor, for example, charges $50 for each runtime version of an IconAuthor presentation you make. Authorware has a similar arrangement, but gives you free runtimes when you don't charge your users for the programs you are creating. And as for cross-platform capabilities, Authorware offers Macintosh and PC versions, while the upcoming Version 5.1 of IconAuthor will run on PC, Mac, Unix, and OS/2 platforms.

Two years ago, when we last looked at this bunch, authoring systems cost even more and had tougher licensing policies. But even today, the packages reviewed here should be stamped "for professional use only." They produce multimedia presentations to die for, but not without some near-death experiences.

Macromedia Inc.

Authorware Professional for Windows

BY ERICK AND LINDA VON SCHWEBER

Macromedia's Authorware Professional for Windows, Version 2.0.1, is like a Japanese superbike: powerful, agile, and reliable. A winner of last year's Editors' Choice, the upgraded Authorware is designed for multimedia professionals who need performance and dependability with a minimum of down-and-dirty programming. It's expensive, priced at $4,995, and can be challenging at times, but the results can be spectacular.

Authorware produces kiosk applica-

PC MAGAZINE

EDITORS' CHOICE

- **Authorware Professional for Windows, Version 2.0.1**
- **IconAuthor for Windows, Version 5.0**

Both of our Editors' Choice winners are powerful tools for creating multimedia applications—whether they're intended for use as self-running kiosk presentations or as computer-based training (CBT) modules. In addition to their substantial power, both packages rely upon a flowchart paradigm for organizing your presentation. The type of applications you need to produce will determine which package is right for you.

If you need to get up and running quickly, AimTech Corp.'s $4,995 IconAuthor for Windows, Version 5.0, is the better choice. It provides a graphical interface, pop-up dialog boxes, and a Smart Object Editor that lets you easily create fully functional objects such as timers, buttons, and scroll boxes. With tools like these, even nonprogrammers can quickly create applications that look, feel, and operate like standard Microsoft Windows applications.

Where IconAuthor really shines is in the production of standard CBT applications. It easily handles data masks and validation, and can read and write dBase files directly. And, for now at least, it's the only package that supports OLE.

IconAuthor may be easier to learn, but Macromedia's $4,995 Authorware Professional for Windows, Version 2.0.1, will take you farther. Once you get past the initial learning curve, you'll find this package can quickly create bulletproof interactive simulations with movable objects, drag-and-drop integration, hyperlinking, and path-based animations.

Authorware's no slouch at kiosk creation, either. Its video capabilities are truly impressive. The package provides extensive controls for Video for Windows files, as well as a video icon and proprietary video drivers that make accessing a laserdisk player a snap. Also, with Authorware you can develop applications on a Macintosh or on your PC.

One big difference between these packages is in their pricing structures for runtime distribution. AimTech charges $50 for IconAuthor's runtime player (which drops to $10 per copy if you buy 250 or more copies), if it's being used for internal distribution. If you're developing a commercial application, AimTech will negotiate royalties. Macromedia, on the other hand, provides its runtime player free for internal distribution. Macromedia, too, will negotiate a fee for commercial distribution.

Both packages are complex and sophisticated pieces of software that have earned the designation "for professional use only." Invest a little time with them, and you'll be able to create truly impressive multimedia applications.

tions as if they were child's play, but its forte is in simulation-style CBT's—where users can interact with a virtual system, manipulate its controls, and receive feedback—all while the program monitors their performance and offers assistance. Authorware derives its power from no less than four programming paradigms, though it lacks a single integrating framework. It visually represents procedural programming with overtones of object orientation, data-driven programming, and parameter-based fourth-generation languages (4GLs).

This amalgam of features works reliably, but the integration of the programming elements is far from seamless. Consequently, you never know where one approach is going to end and another one will begin. Neither simple logic nor past experience (regardless of your background) will prepare you for Authorware's idiosyncrasies: There's simply no substitute for time on the road.

SUITABILITY TO TASK

Authorware Professional

	POOR	FAIR	GOOD	EXCELLENT
Kiosk creation	●	●	●	●
Runtime creation	●	●	●	○
CBT creation	●	●	●	●

INTERFACE ACTION

Authorware's interface, while not quite perfect, is accessible to artists and designers as well as programmers. Using a visual paradigm, Authorware builds applications as icons on a flowline (according to the order of execution). Most icons are simplistic, performing only one function, such as displaying bitmaps or playing a .WAV file. Map icons group other icons into modular subroutines that can be nested, providing a drill-down capability. The Calculate icon is a catchall, providing for variables, functions, DDE, MCI, and more. When viewed from the flowline, however, the calculate icon gives no clue as to its purpose.

Decision and Interaction icons are bundles of low-level programming functions that structure other icons into an application. Simply dragging an interaction icon from the icon palette onto the flowline creates a high-level structure that, when properly filled out with other icons, can display graphics, text, video, and animation; solicit user input; provide feedback; and conditionally branch, loop, and exit. Through this technique, we built a powerful menu system without having to resort to standard programming constructs such as loops, if-then statements, and iteration.

This is where Authorware is at its most powerful and its most confusing. While it is easy to drag icons onto the flowline, it's not so easy to know how they will behave once you get them there. The documentation lacks a clear description of the multiple programming constructs that are represented by the icons and their interrelationships on the flowline. It instead depends on graphic examples, many of which contain errors, and the package doesn't offer on-line help. Consequently, we had to call tech support often; fortunately, they are accessible, knowledgeable, and helpful.

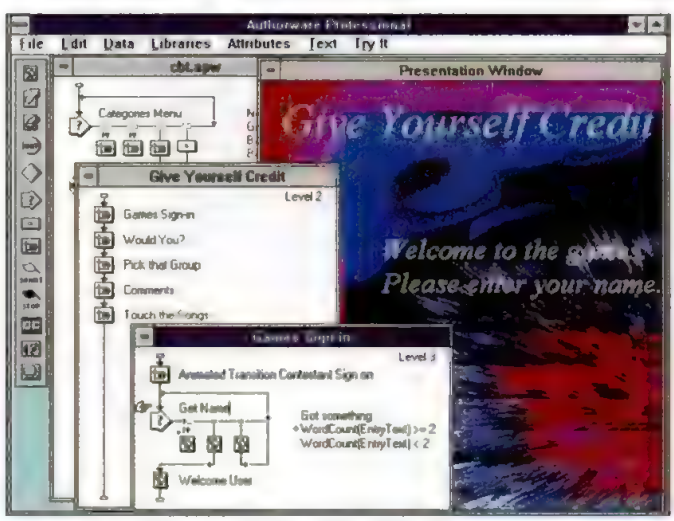
SLEIGHT OF HAND

Our tests called for the display of 13 video clips and their descriptions, for which we created one generic scrolling text screen. By updating a variable with the appropriate text file name, we were able to load the correct text file into the generic display screen. Using this technique throughout gave the impression of 44 distinct screens while we explicitly designed only six.

Curiously, data validation is a major undertaking in Authorware. Only one array is available, and OLE support is missing. Although Authorware by itself can only read and write ASCII files, it gains read and write access to all dBase-compatible files, 17 SQL databases, Btrieve, Microsoft Excel, and Paradox by adding Q+E Software's Database Library DLL. We did not test this feature, but it appears to be straightforward.

On the other hand, we were impressed with Authorware's proprietary video capabilities. Using the video icon and one of the few proprietary drivers, we accessed the laserdisk player and displayed a selected clip in a scaled video window with Creative Labs' Video Blaster by simply drawing a properly colored rectangle on the screen.

After replacing the Video Blaster with the Matrox Marvel video board, we had to resort to Authorware's MCI implementation. Although this is not well documented, the results were im-



Using nested icons, Authorware Professional forces you to work in small, modular blocks of code and allows you to drill down to see the details.

FACT FILE

Authorware Professional for Windows, Version 2.0.1

Macromedia Inc., 600 Townsend St., San Francisco, CA 94103, 800-945-4061, 415-252-2000; fax, 415-626-0554

List price: $4,995.

Requires: 386-based PC or better (486 recommended), 4MB RAM (8MB recommended), 11MB hard disk space (40MB recommended), VGA display or better (256-color Super VGA recommended), Microsoft Windows 3.*x* (CD-ROM drive, Windows-compatible sound card recommended).

In short: Authorware is a powerful, bulletproof program for creating multimedia presentations, kiosks, and CBT applications. Its idiosyncrasies take time to understand, but your reward for persevering is being able to turn out distinctive multimedia projects rapidly.

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pressive. We were able to tap the Marvel's digital video effects to move, resize, tumble, posterize, dissolve, and zoom in on video within our Authorware application. For handling digital video, the Movie icon is irreplaceable. This icon gives you a full array of controls for Video for Windows (.AVI) files.

Authorware's secret power resides in its Animation icon. While not providing true cel animation, the icon enabled us to move a looping .FLC file from left to right along the bottom of the screen, chased by text, simply by setting the destination for each object and the duration of the movement. Beyond this, complex paths can be drawn and movement along them controlled at runtime via variables, providing the basis for powerful simulations.

Authorware automatically builds standard Windows push buttons, pull-down menus, and text-entry scroll boxes, and includes touch-screen areas, clickable objects, movable objects, and keystrokes. Interaction is extended with conditionals and time/tries limits. Movable objects made it easy for us to design a game in which the user dragged a bitmap of a CD cover to a CD player to hear a song.

Sound, however, is another story. Authorware uses three completely different methods to play MIDI files, .WAV files, and audio CDs, which seems a confusing and inconsistent way in which to handle sound. MIDI and .WAV files are controlled via two different icons, while CD audio requires MCI commands. Each of these methods works, but they're all more complicated than they should be.

For delivery, Authorware produces a compiled file, but you must manually include some resource and .DLL files in your distribution. You can distribute free programs without royalties, but you have to buy a publisher's license to distribute commercial programs.

Authorware offers power for the power-hungry and may well become the preeminent tool in your Windows multimedia authoring arsenal. Take plenty of time learning its ins and outs on some back streets, then find a long stretch of blacktop, open up the throttle, and leave the competition in the dust.

Microsoft's Viewer

by Pauline Ores

You may never have heard of the Microsoft Multimedia Viewer Publishing Toolkit (Version 2.0 lists for $495), but you've most certainly used applications created with it—including Windows Help in Microsoft Excel or any number of other Windows-based packages. As a publishing toolkit rather than a multimedia authoring product, it is primarily designed for creating "content" titles, such as reference works, rather than kiosk or CBT applications. But this isn't to imply that you can't create a multimedia application using Viewer. Microsoft itself, not a small player in the creation and distribution of multimedia titles, has relied on Viewer as its authoring tool for its Bookshelf, Cinemania, and Encarta products.

Viewer differs from traditional multimedia authoring systems in three ways: It offers more extensive search capabilities than most, it sports a familiar user interface, and nondevelopers can easily create with it. Like the authoring products reviewed here, the Multimedia Viewer is extensible and can work with DLLs and programs written in the C programming language, and it can support all MCI-controllable media.

A NONPROGRAMMER'S FRIEND

Viewer's authoring metaphor is based on Microsoft Word rich-text-format (RTF) files, making it easy for content originators, such as traditional manuscript authors who are familiar with word processors, to use the product. As a result, programmers are free to concentrate on adding interactive functionality to the ensuing application by adding DLL extensions and C programming. And users will find your applications unintimidating as well: If they've ever used a Windows program's help system, they'll find Viewer's interface familiar and comfortable.

Authoring your interactive project is only part of the process—distribution also plays a key role. The royalty-free runtime program requires a multimedia PC with a 386SX/16 CPU, at least 2MB of RAM, and a CD-ROM player. (Viewer can also output files to floppy disks via "Design and Build Your Deck," a package created with Viewer.) Viewer also supports the Sony Multimedia CD and Tandy Video Information System (running Modular Windows) platforms.

While Viewer supports all multimedia elements, such as audio and animation, its real strength is the hypertext access it offers—what Microsoft calls hypermedia. Jumping from place to place can be disconcerting, but Viewer maintains a history of your hypertext travels, allowing you to retrace your steps.

Viewer offers a standard search interface, which developers can customize. Viewer supports five standard search fields: words, numbers, dates, epochs, and times. Developers can create custom fields for specific titles as well. Viewer also lets users perform wildcard searches and specify search proximity. Developers can deliver search results ranked by relevancy to user-defined topics and can let users work with partial words and lists of keywords linked to topics.

If you are distributing to a wide number of users, you may find that Viewer's royalty-free runtime distribution (for Windows only), lowest-common-denominator approach, and familiar user interface all benefit your project. Additionally, if your application is intended as a reference work, the breadth of search options may make this the perfect authoring solution. □

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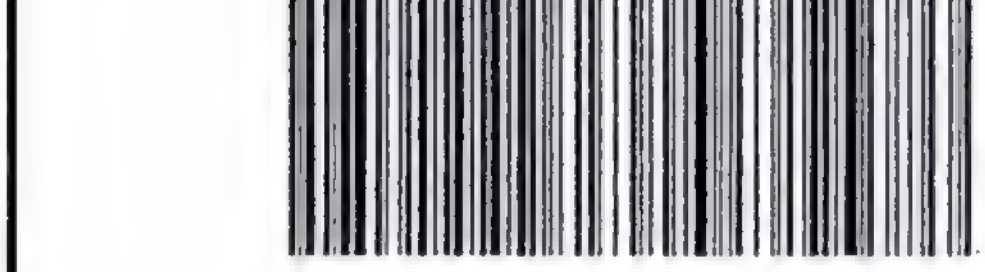

Back

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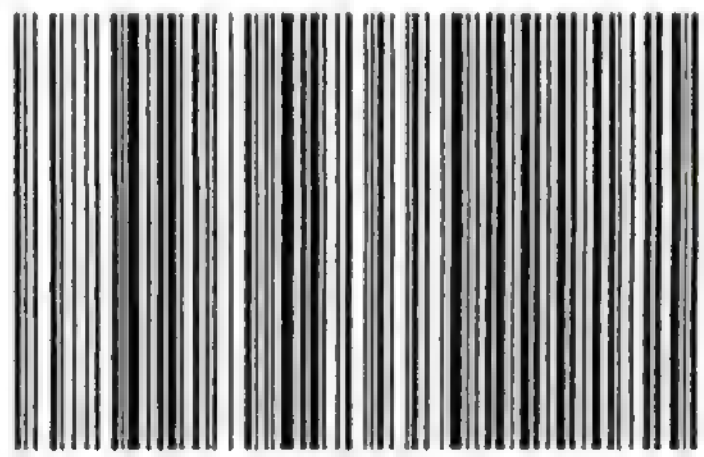

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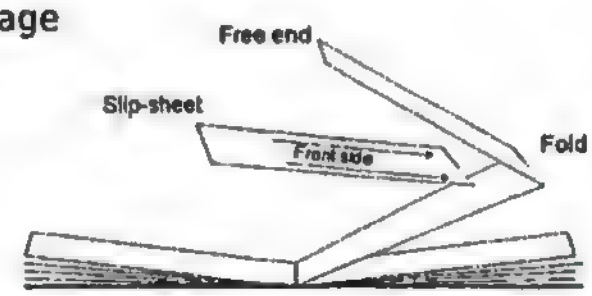

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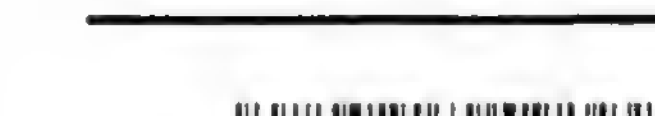

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Introducing the

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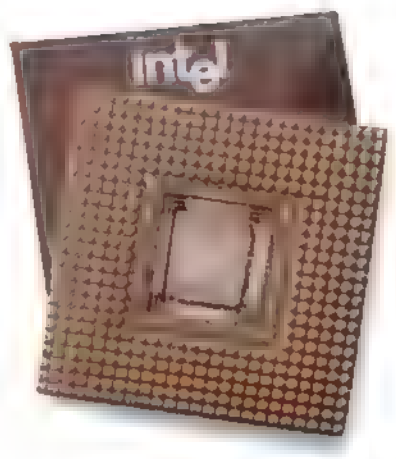

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other guys do—in nothing flat.

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So we wouldn't

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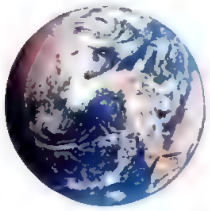

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AimTech Corp.

IconAuthor for Windows

BY LUISA SIMONE

AimTech Corp. boasts that its $4,995 IconAuthor for Windows, Version 5.0, is a professional multimedia authoring system for nonprogrammers. To be more accurate, IconAuthor's graphical interface, pop-up dialog boxes, and supplementary editing modules allow even nonprogrammers to *master* programming functions, not merely use the program. IconAuthor's system is so logical that before you know it, you are working comfortably with if-then branches and loops—functions that would ordinarily intimidate nonprogrammers.

IconAuthor's toolbox and ribbon bar provide a wide variety of tools that help you manage the hundreds of icons needed to complete a presentation. For example, in order to create a presentation, you arrange icons in a flowchart. Each icon represents an event, and the structure of the flowchart controls the sequence of events.

On the simplest level, you can magnify a portion of the flowchart or zoom out to get an overview of the presentation. On the most subtle level, however, you can clean up a presentation by using more sophisticated logic. Instead of cluttering a flowchart with 20 simple Display icons to show a sequence of 20 different pictures, you can create a much more elegant flowchart using one Display icon in conjunction with the powerful Indexed Loop icon.

Ultimately, your applications are only as good as the information they contain. When you double-click on an icon, you are presented with its associated dialog box where you can load picture files, create and manipulate variables, or access multimedia devices and external programs. IconAuthor earns extra points by providing additional functions in these dialog boxes. While most programs allow you to define hot spots that trigger branching functions by drawing rectangles interactively on-screen, IconAuthor allows you to pull up a picture, text screen, or even a video frame for visual reference.

SUITABILITY TO TASK

IconAuthor

	POOR	FAIR	GOOD	EXCELLENT
Kiosk creation	●	●	●	●
Runtime creation	●	●	○	○
CBT creation	●	●	●	●

AGE BEFORE BEAUTY

IconAuthor allows you to create or edit the content of your presentation on the fly by shelling out to four external modules: The Graphics Editor, IconAnimate, RezSolution, and the Smart Object Editor. While these modules provide you with sufficient flexibility, several of them are beginning to show their age. The Graphics Editor, for example, is a bare-bones paint program that is further limited by a 16-color palette. The RezSolution utility, which allows you to convert, resize, and resample bitmapped pictures, can only handle three file formats: .BMP, .PCX, and .RLE.

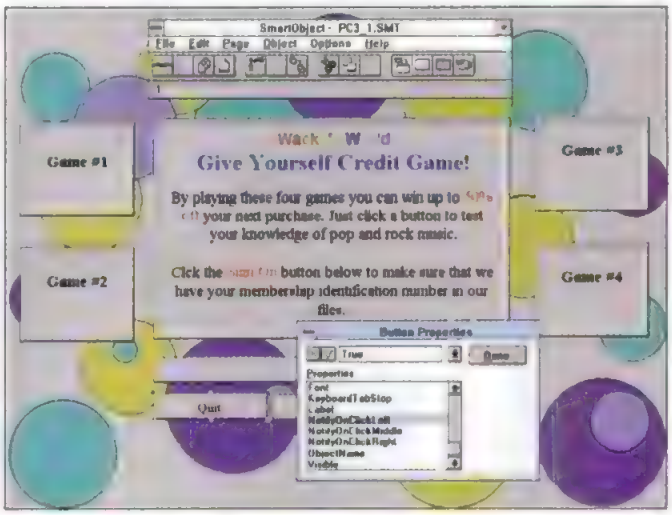
Despite their limitations, all of the modules proved very useful during our testing. Though the IconAnimate module is really suited to sprite-like animation, it was more than up to the task of moving the image of a spinning compact disc across the screen.

It's no surprise that the newest module—the Smart Object Editor, which you can treat as a robust text editor—is also the most powerful. For example, creating a multiple-page document is an efficient way to manage sequential text screens in a presentation. But the Smart Object Editor's real power lies in the functional attributes that can be assigned to buttons, option boxes, list boxes, and timers. A button object can be programmed to respond to a mouse click, and a list box will scroll to reveal hidden text.

POWER METER

One of the best barometers of a multimedia authoring system's power is its ability to access external devices such as videodisk players and sound boards. IconAuthor supplies a slew of proprietary drivers for video overlay cards and video sources.

While IconAuthor's various video icons made it downright easy to crop, resize, reposition, and play video segments on our test suite, controlling other forms of multimedia—such as MIDI or .WAV sound files—forces you to use MCI commands. IconAuthor provides composite



IconAuthor's Smart Object Editor lets you create functional objects such as a Quit button, which can respond to a mouse click.

PC MAGAZINE EDITORS' CHOICE

FACT FILE

IconAuthor for Windows, Version 5.0

AimTech Corp., 20 Trafalgar Square, Nashua, NH 03063; 800-289-2884, 603-883-0220; fax, 603-883-5582

List price: $4,995; runtime utility, $50 (volume discounts available).

Requires: 386-based PC or better, 1MB RAM (2MB recommended), 3MB hard disk space, EGA display or better, DOS 3.1 or later, Microsoft Windows 3.x (Microsoft Multimedia Extensions recommended).

In short: If you can organize a flowchart, you can build an application using IconAuthor. Great control over variables and fully functional objects make this a nearly perfect environment for CBT development. The one major flaw: a comparatively expensive runtime utility that cannot be compiled.

442 ON READER SERVICE CARD

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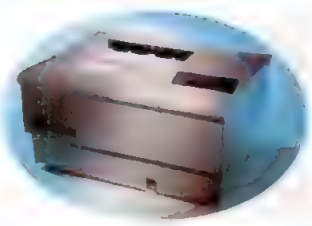

CIRCLE 394 ON READER SERVICE CARD

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▶ SUMMARY OF FEATURES CONTINUES

Multimedia Authoring Software

Products listed in alphabetical order ■ = YES □ = NO	Authorware Professional for Windows (PC MAGAZINE EDITORS' CHOICE)	IconAuthor for Windows (PC MAGAZINE EDITORS' CHOICE)	Multimedia ToolBook	TIE Authoring System for Windows	TourGuide for Windows
List price	$4,995	$4,995	$695	$2,450	$3,370
General Features					
Unlimited runtime version	■	□	■	□	■
On-site training included	□	■	□	□	□
Additional platforms supported	Macintosh	Macintosh, Unix	None	Unix	None
Accepts DLLs	■	■	■	■	□
DDE send/receive	□■	□■	■■	■■	□□
OLE support	□	■ (client only)	□	□	□
MCI	■	■	■	■	■
Developer Interface					
Icon flowcharts	■	■	□	■	■
Nested flowcharts	■	■	□	■	■
Interface	Graphics-based	Graphics-based	Graphics-based	Text-based	Text-based
Multiple documents open	□	■	■	■	■
Zoom views	□	■	■	□	□
Ribbon bar or toolbox	■	■	■	■	■
Debugging utility	■	■	■	■	■
Security privileges:					
Create and edit	□	■	■	■	□
Access and read only	□	■	■	■	□
Hide menu bars	■	■	■	■	□
Hide title bars	■	■	■	■	□
Programming					
Datatype variables:					
Array	■	■	□	■	□
Integer	■	■	■	■	■
String	■	■	■	■	■
User-definable	■	■	■	□	■
Data validation	■	■	■	■	■
Paradigms:					
Object-oriented	■	■	■	■	■
Parameter-based	■	■	■	■	■
Procedural (scripting)	■	□	■	■	■
Template	■	□	■	■	□
Scoring	■	■	■	■	■
Timing	■	■	■	■	■
User-interface objects:					
Alphanumeric entry	■	■	■	■	■
Check boxes	■	■	■	■	□
Dialog boxes	■	□	■	■	■
Drag-and-drop	■	□	□	■	□
Pull-down menus	■	■	■	■	□
Push buttons	■	■	■	■	■
Radio buttons	□	■	■	■	□
Navigation					
Dynamic hyperlinks	■	□	■	■	■
Forward/Backward	■■	■□	■■	■■	■■
GOTO commands	■	□	■	■	■
Jumps to start or finish	■	■	■	■	■
Video					
Drives VCR/videodisk player	■■	■■	■■	■■	□■
Runs video cropped and full-screen	■	■	■	■	□
Supports keyed overlays	■	■	■	■	■

icons that contain the appropriate MCI commands and the correct syntax for these functions. Ultimately, you'll have to work through the intricacies of MCI commands on your own. You'll also find yourself grappling with MCI or DLL calls if you want to display animation files in either the Animator Pro or QuickTime formats.

When it comes to developing CBT applications, however, IconAuthor gets straight As. The program can execute logical and mathematical operations with either single-value or indexed variables. By using variables, you can store, retrieve, validate, and even link text strings. These functions are especially powerful when used in conjunction with external programs and databases. The PC Magazine Labs test CBT simulation, for example, included a request for an ID number. Using standard icon-based functions, we validated the entry with a text mask, stored the number in a variable, searched an external database (in dBASE format) to locate the ID number, and returned a welcome message to the screen that included the user's name and outstanding balance.

Playback is the last—and perhaps most important—part of the development process. IconAuthor stresses cross-platform compatibility with versions that run within OSF/Motif, Vax VMS, and Modular Windows environments. Also, a Macintosh playback program should be available by the time you read this. But IconAuthor's runtime utility, IconAuthor Present, exhibits several drawbacks. It only runs under Windows—an overhead that may be too high for low-end CBT machines or kiosk presentations. The final applications cannot be compiled into a single executable, which means that you will have to maintain lots of uncompressed files. Finally, at $50 a copy (or $10 if you buy 250 copies or more), IconAuthor Present may just be too expensive. If you are marketing a commercial program, AimTech will negotiate a royalty instead.

Even with all its power, IconAuthor is not a perfect authoring system: For example, it currently employs an awkward default directory structure that makes working simultaneously on more than one project difficult. But an upcoming release (Version 5.1) should address many of the

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LOTUS CC:MAIL	YES	NO	NO	NO

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CIRCLE 086 ON READER SERVICE CARD

SUMMARY OF FEATURES ENDS

Products listed in alphabetical order ■ = YES □ = NO	Authorware Professional for Windows	IconAuthor for Windows	Multimedia ToolBook	TIE Authoring System for Windows	TourGuide for Windows
Device Synchronization					
Concurrent timing	■	□	■	■	■
Event-driven timing	■	■	■	■	■
Data Files					
ASCII (delimited or fixed-length)	■	■	■	■	■
dBASE	■	■	■	□	□
Proprietary	□	■	■	■	□
Q+E Database Library	■	■	■	□	■
Graphics					
Maximum number of display colors	16.8 million	16.8 million	16.8 million	256	256
Maximum number of editable colors	256	256	16.8 million	256	256
Gradient color	□	■	□	□	□
Transition effects	■	■	■	■	■
Animation					
Point-to-point	■	■	■	■ (play only)	■
Straight line/Curved path	■■	■□	■■	■■ (play only)	■■
Simple cel animation	■	□	■	■ (play only)	■
Video					
Microsoft Video for Windows	■	■	■	■	■
QuickTime for Windows	■	■	■	■	□
Text					
Add drop shadows/frames	□□	□■	■■	■■	□■
Bevel text	□	□	□	■	□
Extrude text	□	□	□	■	□
Fit text to curve	□	□	□	■	□
Rotate/sweep text	□□	■□	□□	■□	□■
Use outline fonts	■	■	□	■	□
Sound					
Loop					
Repeatedly	■	■	■	■	■
Until another event occurs	□	■	■	■	■
Kill					
Explicitly	□	■	■	■	■
Upon another event	■	■	■	■	■
When a new sound begins	□	■	■	■	■
File Importing					
Animation					
FLC and FLI	■	■	■	■	■
MMM	■	■	■	□	□
Graphics					
BMP	■	■	■	□	■
EPS	■	□	■	□	■
GIF	□	□	■	■	■
PCX	■	■	■	□	■
PIC	■	□	■	□	□
PICT	□	□	■	□	■
RLE	■	■	□	□	■
TGA	□	□	□	□	■
TIFF	■	□	■	□	■
WMF	■	■	■	□	■
Other	PCT, PNT	None	CGM, DIB, DRW, DXF	None	DCX, JPEG, WPG
Sound					
CD audio	■	■	■	■	■
MIDI and WAV	■	■	■	■	■
SND	■	■	□	■	□

program's current shortcomings. Hypertext links and drag-and-drop input will both be fully supported in the new version.

Whether you are creating kiosk presentations or developing CBT applications, you'll find IconAuthor an all-around top performer. This authoring system provides a rich, accessible, and extensible toolset that meets the needs of programmers and nonprogrammers alike.

Asymetrix Corp.

Multimedia ToolBook

BY STEPHEN W. PLAIN

Fittingly called a "software construction set for Windows," Multimedia ToolBook, Version 1.53a, from Asymetrix Corp., provides developers with a flexible and extendable tool for building multimedia applications. Because the package requires a considerable amount of coding for most applications, it's strictly for programmers who need to produce highly sophisticated applications with few limitations. Multimedia ToolBook lists for $695 with unlimited runtimes.

Asymetrix's ToolBook is a visual development environment that employs a book metaphor similar to the stack concept used in the popular Macintosh program, HyperCard. It's an event-driven system that exploits the highly interactive nature of the Microsoft Windows environment. Multimedia ToolBook, however, is a special version of ToolBook with a set of DLLs and sample books that serve as multimedia extensions to the program.

An application in Multimedia ToolBook is referred to as a "book" and is composed of screens called pages. Each page can contain native objects such as buttons, fields, and graphics, or imported objects such as bitmaps, sounds, and video clips. You can define a common background that contains all of the visual and interactive elements that should remain consistent in a book.

Each object you place, either in the background or the foreground of a page, can be given functionality by means of an attached script of code. These scripts are made up of code sections called handlers, which respond to various events such as MouseDown and EnterPage. You can de-

fine your own events with their associated code, which can be called from anywhere in the book.

IN ENGLISH, PLEASE

Although Multimedia ToolBook is code-based, its language is relatively easy to use. It resembles English more than most programming languages, with phrases such as "[[CODE START]]put the text of it into Sales[[CODE END]]" and "[[CODE START]]request 'Are you sure you want to quit this book?' with 'Yes' and 'No'[[CODE END]]". You don't, however, have to code everything from scratch: Multimedia ToolBook includes a book called Multimedia Widgets that is full of predefined objects and codes. Buttons and controls for MIDI and .WAV files, sample animations, timer controls, and controls for videodisk players are among the widgets supplied.

Unlike products such as IconAuthor and Authorware, Multimedia ToolBook does not come with any specific drivers for commonly used peripherals such as sound boards and videodisk players. Rather, the package depends exclusively on the Windows MCI layer for access. (For hardware not accessible through the MCI, you can use ToolBook's DLLs.) While working with MCI commands makes your task more difficult, it does keep your application device-independent.

FACT FILE

Multimedia ToolBook, Version 1.53a

Asymetrix Corp., 110 110th Ave. NE, #700, Bellevue, WA 98004; 800-448-6543, 206-462-0501; fax, 206-455-3071

List price: $695

Requires: 386-based PC or better, 2MB RAM (3MB recommended), 6MB hard disk space, VGA display or better, Microsoft Windows 3.*x* (CD-ROM drive and Windows-compatible sound card recommended)

In short: As a special version of Asymetrix's ToolBook, Multimedia ToolBook is an invaluable tool for professional multimedia developers, who will be impressed with its ability to allow easy animation creation. Though the programming language is simple, it should be labeled "for professional use only": ToolBook does require a lot of coding, so the multimedia novice may want to avoid this one.

443 ON READER SERVICE CARD

Guide to Clip-Media Software

It's hard enough piecing together all the elements for a multimedia presentation, and it doesn't get any easier if you have to acquire and edit your own video or audio clips. But don't worry. Just as clip art has enlivened desktop presentations, clip-media packages—typically CD-ROMs containing video, audio, or Kodak Photo CD images—can help you create a jazzy multimedia presentation with little fuss. The range of offerings in the products listed below includes music videos and clips from classic films. But make sure you understand the copyright issues involved in your package: You can include a snippet of a Lou Reed video in your presentation, but you may have to pay for it.

AUDIO CLIPS

Products listed in alphabetical order by company ■ = YES □ = NO	Digital Soup **Sound Professional, Version 1.0**	Microsoft Corp **Microsoft Soundbits**	Midisoft **Multimedia Music Library**	MP Technologies **Sound Palette Version 1.0a**	Prosonus **MusicBytes**
List price	$99.00	$39.95	$79.95	$59.00	$99.95
Toll-free number	800-793-7355	800-426-9400	800-776-6434	None	800-999-8191
Toll number	802-254-7356	206-882-8080	206-881-7176	301-907-0042	818-766-5221
Fax number	802-254-6812	206-936-7329	206-883-1368	301-907-0119	818-766-6088
Requirements					
Processor	386 or better	286 or better	386SX or better	286 or better	286 or better
RAM	2MB	1MB	2MB	None	2MB
Sound card	■	■	■	□	■
CD-ROM drive	■	□	□	□	■
Features					
Number of clips	100	50	175	51	134
Formats supported	CD audio, .DSS (proprietary), .WAV	.WAV	MIDI	.WAV	CD audio, MIDI, .WAV
Imports sounds	■	□	□	■	□
Supports stereo output	■	□	□	□	□
Categories					
Music	■	□	■	■	■
Sound effects	■	□	□	■	■
Voice clips	■	■	□	■	□
Options					
Sequences clips	■	■	□	■	■
Fast-forwards and rewinds	■	□	□	□	□
Records from audio CDs	■	□	□	□	□
Edits clips	■	□	■	□	□

VIDEO AND ANIMATION

Products listed in alphabetical order by company ■ = YES □ = NO	GateKeeper	Canyon Clipz
List price	$129.00	$29.95
Toll-free number	800-366-1444	None
Toll number	206-869-6600	415-398-9957
Fax number	206-869-6601	415-398-9964
Requirements		
Processor	386/16 or better	386SX or better
Display	VGA or better	VGA or better
Sound card	■	■
CD-ROM drive	■	■
Microsoft Windows 3.1	■	■
Features		
Number of frames per second	15	12–15
Number of clips	100	30
Compatible with QuickTime for Windows	□	■
Categories		
Movies	■	■
Music videos	□	■

BACKGROUNDS AND PHOTOS

■ = YES □ = NO	Ans Entertainment **Media Clips series**	**Corel Professional Photos series**
List price	$39.95 each ($59.95 for Jets & Props two-disk set)	$49.95 each
Toll-free number	800-228-2747	800-836-3729
Toll number	310-821-0234	613-728-8200
Fax number	310-821-6463	613-728-9790
Number of clips	100 each	100 each
Display required	Super VGA	Super VGA
Formats supported	.BMP, .PCX, .TIFF	.BMP, .EPS, .PCX, .TIFF (files ship in Photo CD format)

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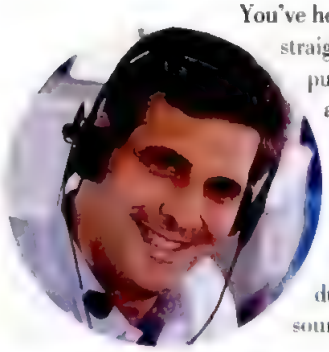

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425SX/Si
i486SX/25MHz, 120MB HD, 4MB RAM
14L8 (IBM Credit Lease: $50/mo.**) $1,369*

433DX/Si
486DX/33MHz[4] 120MB HD, 4MB RAM
14L8 (IBM Credit Lease: $62/mo.) $1,719*

433DX/Si
486DX/33MHz[4] 212MB HD, 4MB RAM
14L8 (IBM Credit Lease: $66/mo.) $1,829*

466DX2/Si
i486DX2/66MHz, 212MB HD, 4MB RAM
14L8 (IBM Credit Lease: $80/mo.) $2,229*

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450DX2/D
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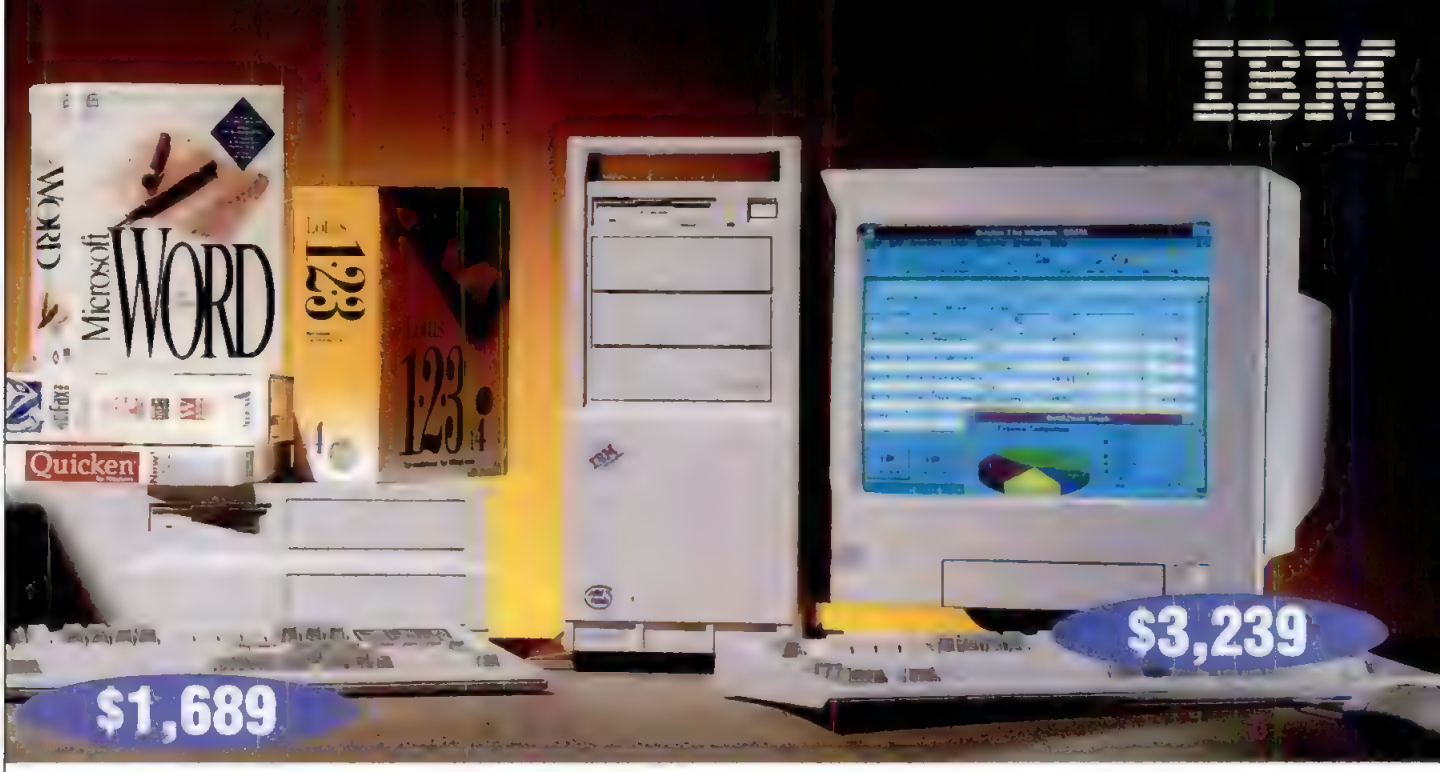

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14L8 (IBM Credit Lease: $93/mo.) $2,569*

466DX2/T
i486DX2/66MHz, 424MB HD, 8MB RAM
14L8 (IBM Credit Lease: $108/mo.) $2,989*

466DX2/T
i486DX2/66MHz, 527MB HD, 8MB RAM
14L8 (IBM Credit Lease: $113/mo.) $3,129*

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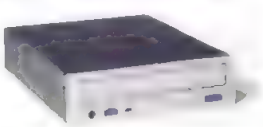

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We're putting the personal in personal computing.

Where Multimedia ToolBook really shines is in creating applications with a high degree of control logic. Since the ToolBook programming language, called OpenScript, is designed for general application development instead of just mainstream multimedia, it offers the programmer seemingly unlimited flexibility. If you do happen to come up against a limitation in Multimedia ToolBook, such as access to other databases, chances are you can get around it by calling up a DLL.

The standard Multimedia ToolBook toolbox contains ten line and shape objects that can be painted on the screen. Also included is a Color Tray that holds 64 colors simultaneously. Each color can be customized using the Spectrum palette, which makes available all of the colors supplied by your video adapter. However, Multimedia ToolBook does not offer 8-bit palette support for coloring objects drawn within the application while in 256-color mode. It only offers 8-bit palette support for imported graphics, which results in a selection of heavily dithered colors (this should be corrected in the next release, however). When we used a 32K color driver, however, the Spectrum Palette offered a smooth selection of all colors.

SUITABILITY TO TASK

Multimedia ToolBook

	POOR	FAIR	GOOD	EXCELLENT
Kiosk creation	●	●	●	○
Runtime creation	●	●	●	○
CBT creation	●	●	○	○

One noticeable absence was the lack of professional drawing tools. Asymetrix prefers to provide import filters for all the major vector-based illustration programs.

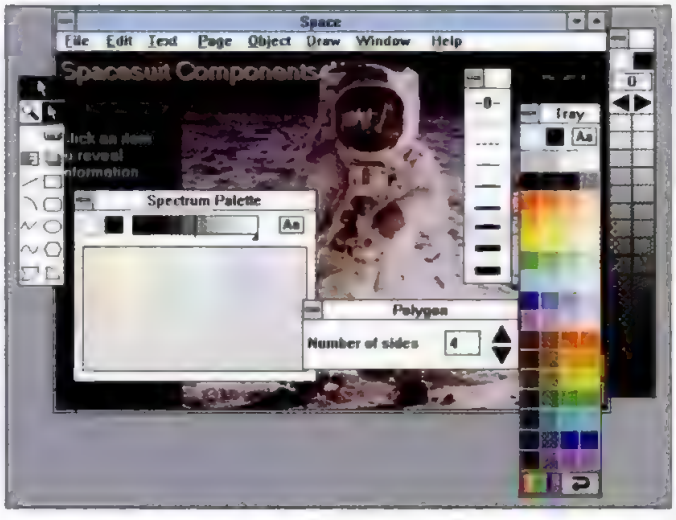
ANIMATION OPTIONS

Multimedia ToolBook offers several ways of building simple animations and includes a primer application. The OpenScript language, for example, supports moving an object from one point to another in a straight line and, by drawing a curved line on the page and then hiding it, you can make the object move along the vertices of that line to create curved-line animations. Another technique involves "flipping" through various bitmaps by changing the associated image for an object or moving images between layers on the page. Each object drawn on a page is assigned its own distinct layer, which can be changed via code to hide or reveal objects.

Creating a hypertext application with Multimedia ToolBook is a snap. Hotwords are defined by simply highlighting the text and choosing the Create Hotword menu item. You can make the hotword take the user to a particular page by using the Link To button or, because each hotword is a distinct object, attaching a script to the hotword to make it do anything you please.

Multimedia ToolBook includes a runtime that can be distributed royalty-free with your applications. This runtime includes a batch file that builds a distribution diskette of your application, but the numerous files that make up the core Multimedia ToolBook runtime and the multimedia extensions probably won't fit on a single diskette.

Multimedia ToolBook requires lots of coding, making it suitable only for those who can answer the challenge of a little programming—not the occasional presentation builder. But with the power it provides in building multimedia applications and simple animations, Multimedia ToolBook is an invaluable tool for the professional multimedia developer.



Various floating palettes provide Multimedia ToolBook developers with a point-and-click environment.

Global Information Systems Technology Inc.

TIE Authoring System for Windows

BY PAULINE ORES

What you see is not always what you get. At first glance, Global Information Systems Technology's (GIST) TIE Authoring System for Windows, Version 4.0, looks like a basic application, but a powerful programming language—reflected by TIE's $2,450 price tag—lies behind that simple front.

Icons in TIE (Training Icon Environment) enable both beginners and advanced users to generate code in GIST's proprietary language, called Tutor. The basic building block within the TIE program is a Unit, which may be an opening screen, a list of initial choices, or whatever makes sense in a particular situation. Each Unit is made up of a series of icons, each of which represents an element of the final project. Units can also be used as subroutines, which saves you time and effort when you're composing a large project.

One of TIE's flaws is the fact that it does not allow you to see an overall flowchart of all of your icons (although you can print out a text outline), which makes keeping track of an elaborate presentation a mental exercise for the creator. The Units are displayed linearly, and you need to double-click and open another window to expand and view them.

BUILDING BLOCKS

As with any complex task, once you become familiar with the logic of the program and understand TIE's method of building Units, it's fairly easy to assemble a finished project—especially a CBT course. A host of multimedia and graphi-

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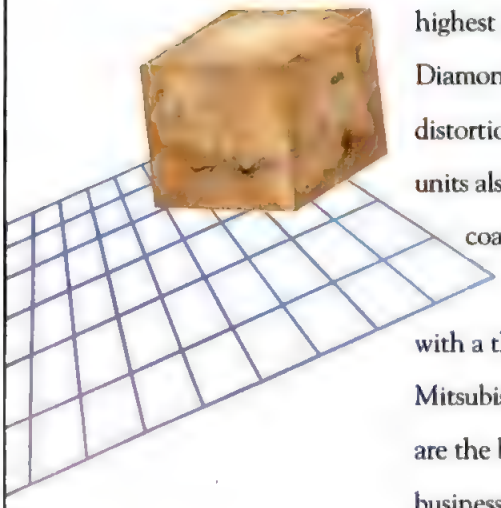

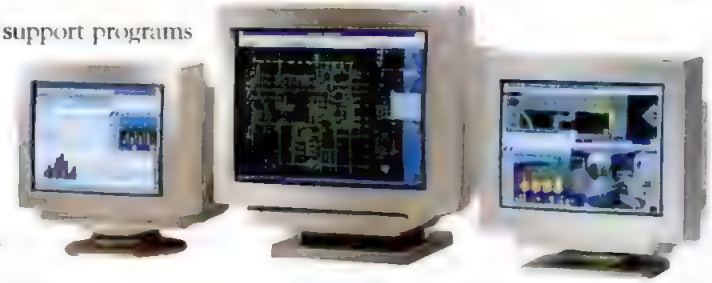

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CIRCLE 280 ON READER SERVICE CARD

What's OS/2 Got To Do with It?

by Erick and Linda Von Schweber

A starfield explodes in front of you, nearly filling your field of view. Your attention is drawn to a loud humming to the extreme right. Asthe sound pans left you discover its source: an immense alien ship, with the stardrives throbbing. You click on the ship and the starfield becomes a worm hole, your ship plummeting down at warp speed. With a *whoosh* you emerge—in the Gamma Quadrant? No, at the main menu. This isn't a new Star Trek arcade game—it's your next marketing presentation, developed with OS/2 multimedia and the environment's full-screen, 30-frame-per second DVI digital video, along with graphical overlays, dissolves, and program-controlled sound.

Do you need OS/2 for these effects today? Maybe. While DVI (Digital Video Interactive) is available within Windows using MCI calls, on the OS/2 platform you have Ultimedia Builder/2 and the MediaScript Desktop Edition, Version 2.0—programs specifically designed to exploit the Intel Action-Media II board and make digital video authoring easier.

If, however, your application calls for analog video—from a laserdisk, for example—you may be better off in Microsoft Windows. IBM's M-Motion adapter is infamous for its difficulty in installation. And forget OS/2 if you want to use industry-standard .FLC animation files because you can't—OS/2 is limited to IBM's old-style sprites.

Furthermore, creating multimedia applications on this platform will require you to invest in specialized hardware. We had to evaluate the OS/2 products on an IBM Ultimedia platform, since they would not run on the standard multimedia authoring test-bed. Be sure any hardware you decide to use has OS/2 drivers available as well.

IMPULSE POWER

IBM's Ultimedia Builder/2 ($345) is a pleasant environment for the construction of multimedia presentations, kiosks, and CBT applications. It is very accessible to nonprogrammers and easily produces results with great visual excitement and appeal.

Builder/2 provides a graphical user interface to the AVA/2 (Audio Visual Authoring 2) language, an updated version of the venerable AVC (Audio Visual Connection). Builder/2 is interoperable with separately available Perfect Image/2, which allows you to enhance and capture images, and with Workplace/2, a visual light table that shows thumbnails of media files and attaches searchable database fields to them, allowing you to locate and sort multimedia resources easily. Workplace/2 hooks into dBASE, DB2, Oracle, and OS/2 Database Manager. AVA/2 can be extended with C code and DLLs.

Builder/2 lets you flip between two views of your story: a graphical view and a textual view of AVA/2 commands. The graphical view shows a filmstrip of frames containing either thumbnails of images or icons representing one or more AVA/2 statements for playing sound and video files. In this view, you can drag objects from the Workplace/2 light table or you can use Builder/2 icons to load and position resource files. Images can be easily cropped and magnified with your choice of 146 snazzy transitions and text fields are formatted to display variables and collect user input. By adding explicit AVA/2 commands from the textual view, you can produce even MTV-style image-strobing effects.

WARP SPEED

Developers of OS/2 multimedia applications or titles should, however, consider the MediaScript Desktop Edition, from Network Technology Corporation (914-478-4500 ext. 510). This $895 interactive multimedia authoring environment includes a full complement of audio and video capture and playback tools. Applications designed with it can be partially CUA-compliant, with Presentation Manager–style windows, radio buttons, and check boxes.

To produce high-impact presentations using digital video effects, choose one of these OS/2 applications—they give you results Windows is just promising.

To build a project, you string icons (fleshed out via dialog boxes) into scripts, which are then interrelated by a network. The icons are multimedia objects that display images, send messages, play sounds, and more. Display of video is flawless, and you can have up to 32 separate windows open with 32 interactive objects in each window at one time. But be warned: we encountered many problems during testing.

Back in your presentation, your CEO...err...your captain is on-screen, outlining the flight plan. As you rocket through a black hole, your audience screaming for more, you know that this deal was in the stars. To produce high-impact presentations using digital video effects such as these, choose one of these OS/2 applications. With DVI, they give you results Windows is just promising. □

FACT FILE

TIE Authoring System for Windows, Version 4.0

Global Information Systems Technology Inc., 100 Trade Centre Dr., #301, Champaign, IL 61820; 800-327-0565, 217-352-1165; fax, 217-352-9307

List price: $2,450.

Requires: 386-based PC or better (486 recommended), 2MB RAM (4MB recommended), 4MB hard disk space (120MB recommended for audio and video files), VGA display or better, Microsoft Windows 3.1 (any MCI-supported CD-ROM drive, laserdisk player, and sound card recommended).

In short: Though it appears to be rather basic, TIE boasts a deceptively powerful programming language. The program's icon-driven approach will appeal to beginners, but users who need to build many extensive CBT projects will benefit most from this package and from the learning curve required to make it work.

444 ON READER SERVICE CARD

cal effects are available, but nothing that would put any other multimedia program to shame. You can create basic graphical elements, such as background screens with titles, with TIE's small but functional paint program, TIE Paint, which offers both bitmapped and vector graphics modes. More elaborate graphics and images must be pasted into the TIE Paint program via the Windows Clipboard.

A helpful graphics feature allows you to "bring along" other screens (icons) as underlying layers, specifying them by their given icon numbers. This is especially useful when designing an active touch-screen area. While creating the kiosk in our test suite, we were interactively able to draw the active touch-screen area directly over the button graphic we had already drawn, rather than having to work with screen coordinates.

TIE's real strength lies in the breadth of options and tools available for creating testing scripts. Along with animation and graphics icons, its Output Presentation list includes a Test Question icon, which creates a template for multiple choice, true/false, free-form, and matching questions. The developer then enters the questions, correct and incorrect answers, and related feedback statements. These entries are meted out by another series of icons, which includes the Answer, Key, and Touch Input icons. Branching Class icons contain a large array of conditional jump, case expression, and other icons that a developer can use to organize the flow through which a user can navigate.

Although you can assign a description for each icon (as a line of text that appears next to the icon) and create a Unit documentation file, keeping track of an elaborate presentation without a flowchart can be a mentally taxing exercise for the creator—or a real challenge for another user at a later date.

More sophisticated multimedia elements, such as audio, video from a videodisk, and animation, can be added by using a number of Output Presentation icons. TIE relies on Windows' Media Control Interface (MCI) to work with various multimedia elements and devices, and allows users to enter and test custom MCI strings and then save them to an MCI file for reuse. The package also includes two high-level icons to control videodisk players and digital sound. TIE also provides no tools for creating animations. Instead, it relies on an Autodesk DLL in conjunction with its own Animation icon to control the playback of Autodesk Animator or Animator Pro files.

Although TIE works with DLLs, can run executable files, and can launch other applications, you'll need a programmer with access to application calls to actually work with another application or its data files, such as accessing a dBASE-formatted database.

This doesn't mean, however, that TIE is not based on a strong programming foundation. TIE is a multiplatform program, and GIST states that the runtime versions of the lessons created in Windows can be run on X.11 Window (a popular release of X Window, a Unix windowing system) without any modifications. The Unix system version of the runtime player even has the code necessary to replicate the DLL calls.

SUITABILITY TO TASK

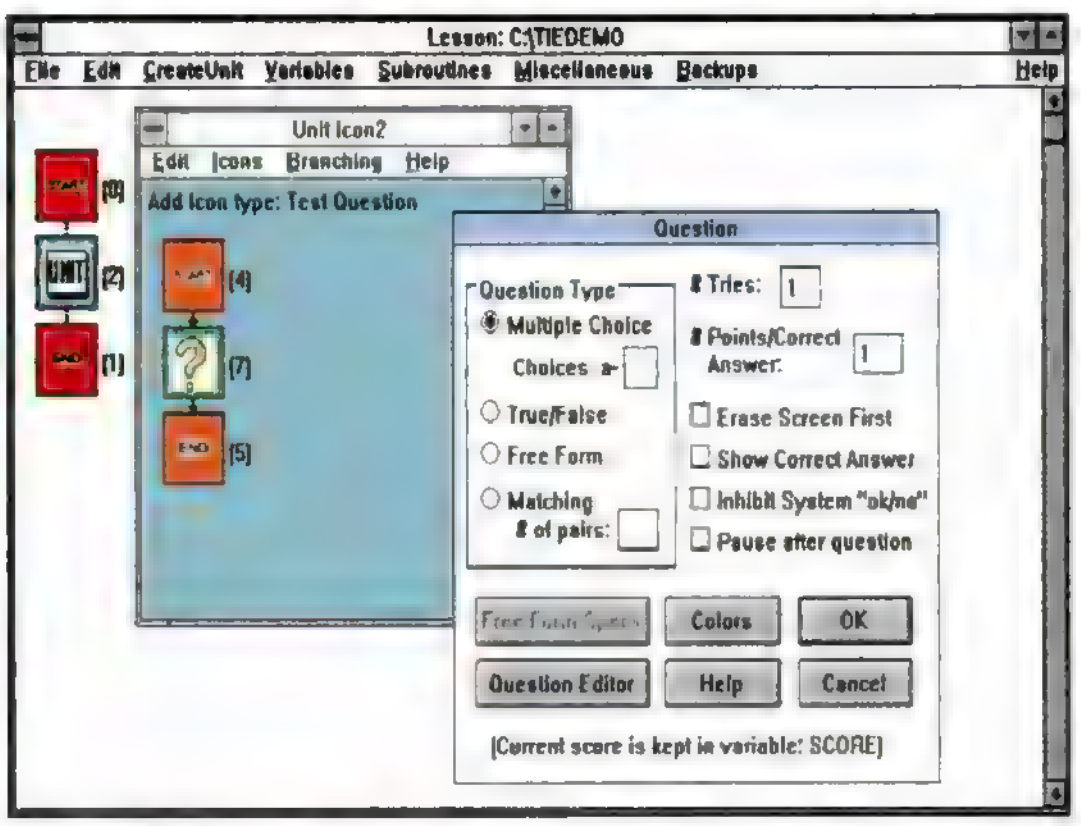
TIE Authoring System

	POOR	FAIR	GOOD	EXCELLENT
Kiosk creation	●	●	●	○
Runtime creation	●	●	●	○
CBT creation	●	●	●	○

COMPILING OPTIONS

As TIE icons generate Tutor code behind the scenes, you need to compile your work before you can run it with the runtime version of the program (the runtime player is included with the TIE creation tool, but developers must pay an additional licensing fee of $1,950, or $20 per runtime module to distribute it). TIE also offers the option of compiling a single Unit rather than the entire program. You can also combine Units into Module Blocks and compile them, allowing you to debug your end application in parts, rather than waiting until you've finished building the application.

While GIST has years of experience in CBT training as well as solid multiplatform experience, TIE's documentation is not on par with what users have come to expect from off-the-shelf applications, which is especially disappointing considering how much this program costs. As a tutorial, the slim Evaluation Exercise, designed to accompany a demon-



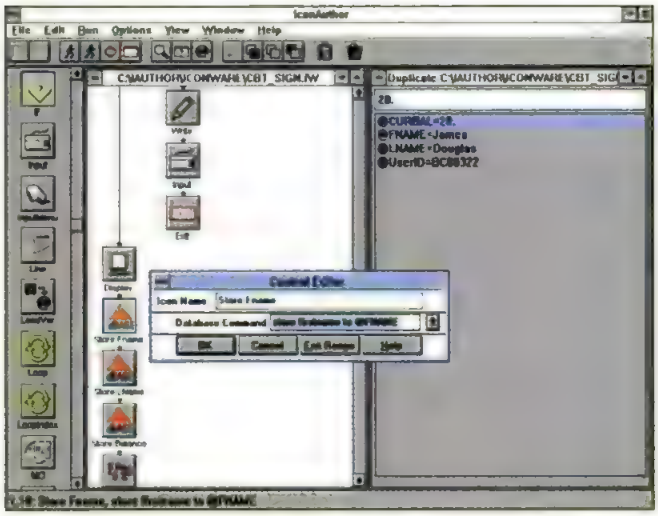
TIE's simple instruction and dialog boxes make creating complex CBT applications much easier.

How We Tested

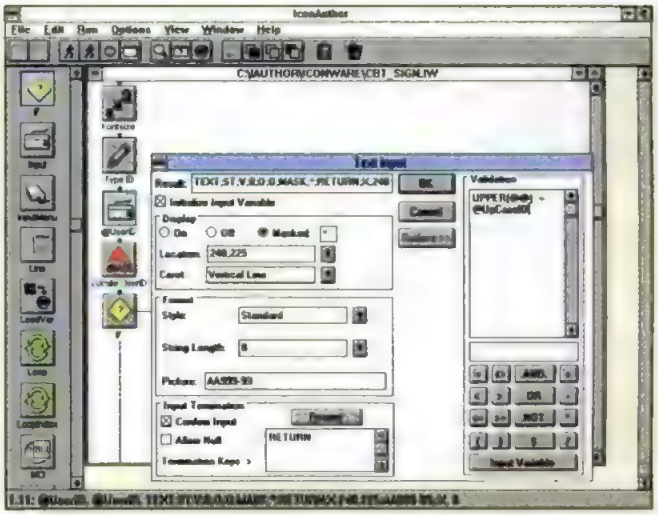
PC Magazine Labs focused on the two most common areas of application design to test the current breed of multimedia authoring packages: kiosk and computer-based training (CBT) development.

Designed to simulate real-world scenarios, our tests used a variety of peripherals, including the Pioneer LE-V8000 Laserdisk player with the Matrox Marvel or Creative Labs' Video Blaster boards to execute the analog video overlay, and the Diamond Stealth Pro ISA Windows accelerator video boards for 800-by-600 display with 256 colors. We used the Media Vision Fusion 16E Multimedia Upgrade Kit to provide the test-bed with a sound board, speakers, and CD-ROM drive. Microtouch's TruePoint DS-33 Touch Monitor provided touch-screen capabilities for our standard test-bed of Compaq Deskpro 486/33M systems configured with 310MB IDE hard disks and 8MB of RAM running DOS 5.0 and Microsoft Windows 3.1

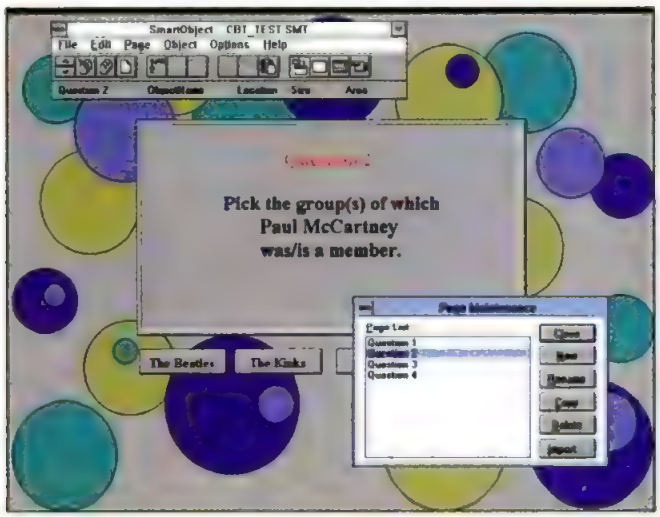
For the kiosk portion of the script, we asked the review-



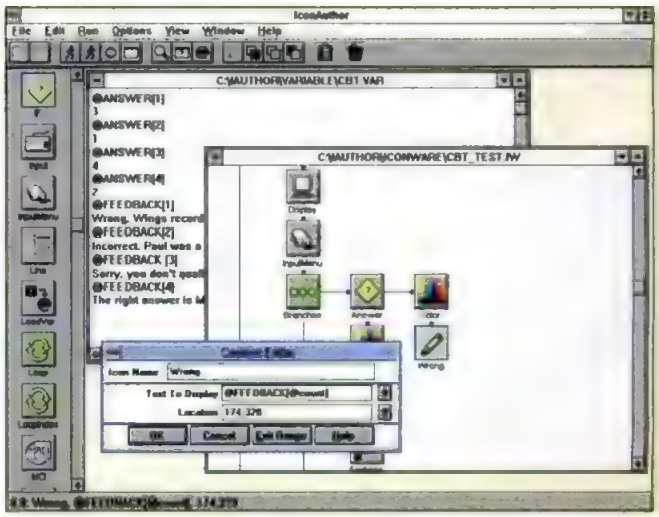
You can see the programming behind the sign-on screen for our test CBT creation. The icons represent structured and stored database files.



Using Boolean formulas helped us evaluate user input and validate responses. Notice the =,>, and < buttons on the "calculator," which simplify the creation of Boolean statements.



We tested all the packages to see if they handled the multiple screens of a CBT application as multiple pages. This question's page was created using the paint module included with the program.



We tested each package's ability to use indexed variables, which would allow us to list and therefore test for the correct answers on a music quiz.

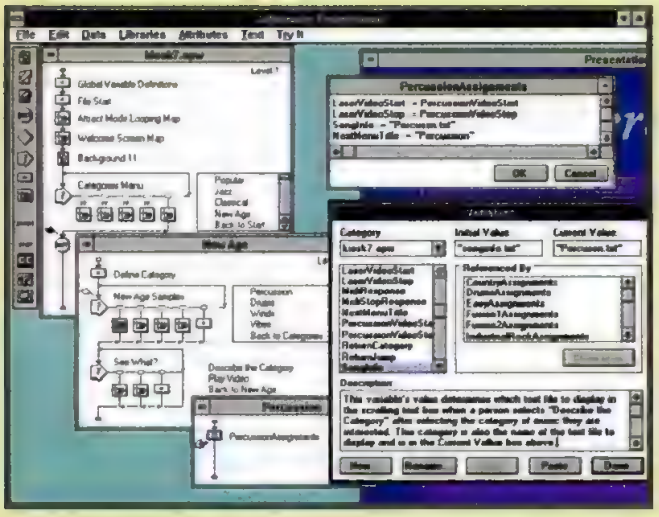
ers to create an interactive music video sampler—one that might be found in a typical record or video store. Our music videos were laserdisk-based rather than digital. We required each package to call an external device (the laserdisk) from within the application and provide a menu-based, touch-screen–navigable system, which took user input and used conditional branching to allow a user to watch and hear videos, as well as to pull up information from text files. We then used an attract-mode loop, which began after 10 minutes of inactivity, to test the timer functions built into each program and launch a 2-minute multimedia presentation.

The CBT portion of our script played off the kiosk's theme. We required each reviewer to take a test in the form of four music video games and, depending on the score, earn up to a 20 percent discount off his or her balance. Reviewers assigned and stored variables for user input, accessed an external database containing accounting information, and performed a variety of calculations and scoring. We used multimedia elements such as MIDI and .WAV files in conjunction with bitmaps and animated sequences to test each application's ability to provide an easy-to-use application interface.

Finally, PC Labs created a standalone runtime version of our kiosk application, which was saved onto floppy disks, to test each package's distribution features and runtime player. PC Labs also played each of these runtime versions to assess the visual quality of on-screen playback.

Reviewers designed a splash screen for the kiosk using a package's text and illustration tools and imported it as a background. Shown here is a transition effect being applied.

Overlaying the analog video without proprietary MCI drivers proved to be a difficult task. In this instance, a menu selection will play one of 15 clips at normal speed.



The ability to assign variables to our SongInfo made it easy to retrieve and execute a response to a menu selection that was linked to a song or artist.

In creating our test kiosk, we formatted text color, font, and size inside a scroll box with a background color. This helped evaluate both the text tools and color handling.

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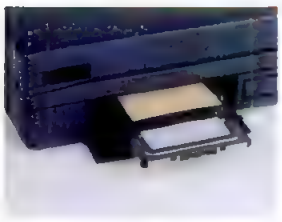

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stration version of the program, is not elaborate enough for beginning users. GIST is aware of this problem and provided us with a draft version of *The Learning Manual*, a much more accessible and detailed tutorial that covers many of the basic how-to questions beginners might have.

TIE tries to be all things to all people, and it comes close, but users who expect to find a standard $500 Windows application multiplied fivefold will be in for a surprise. TIE's interface, while powerful, is only about one-tenth as sophisticated as the latest applications from any other Windows vendor.

TIE Authoring System for Windows is a lot of technology behind a less-than-intuitive front-end. For users who intend to produce several large CBT projects and amortize their initial learning curve, however, TIE is an excellent package.

American Training International Inc.

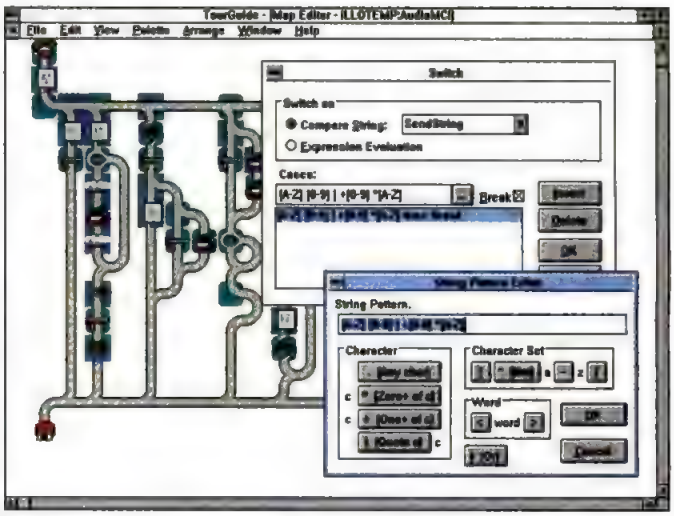
TourGuide for Windows

BY DON LABRIOLA

As its name implies, TourGuide for Windows, Version 1.3, models multimedia applications after road trips. Only power users, however, will be able to go along for the ride with this $3,370 offering from American Training International. This complex package is aimed at experienced developers who aren't intimidated by exotic peripherals, scripting languages, and MCI command strings. Although TourGuide offers hardcore programming capabilities and is especially strong at computer-based training (CBT) development, inadequate documentation and the lack of a few key features make it difficult to learn and use.

The program creates tours by stringing together scenes that contain objects such as text, graphics, sound, animation, and video clips. The logic that controls a tour is stored in a set of maps, which are graphical flowcharts that you create by linking together road-trip icons. To insert a loop into a map, for example, you'd use a traffic-circle icon; an if-then condition would be a road fork, subroutine calls are telephone call boxes, and so forth. Maps can also play multimedia files, manipulate variables, and decide when and how to display scenes and objects.

You can add intelligence to an object or scene by linking it to a map and then specifying events such as keystrokes, mouse clicks, or the arrival of a message from a multimedia peripheral to trigger the map. To create a button that branches to a menu, for example, you'd draw the button, define a map that displays the menu, and then program the button to react to a mouse click by executing the map.



TourGuide's sophisticated string pattern–matching function analyzes the syntax of user input.

Working in this environment is a lot like using a conventional programming language, and it has the same benefits and drawbacks. On one hand, it's flexible enough to let experienced designers put together highly sophisticated applications. But all this flexibility comes at a price: Without good software engineering discipline, it's easy to create sprawling, unmanageable applications—a situation that's aggravated by the program's meager selection of debugging aids.

MULTIMEDIA MANIPULATION

TourGuide provides easy-to-use multimedia tools for manipulating video files, graphical images, MIDI and .WAV files, and CD audio. Although there's no built-in support for laserdisk players, video overlay cards, or VCRs, you can control any MCI-compliant peripheral by using TourGuide to transmit command strings manually. During our testing, we found that it was possible to interface virtually any device that works with Microsoft Windows, provided you're familiar with Microsoft's MCI specification. The package prefers to work with digital video, such as .AVI and .DVI files.

TourGuide's other advanced features include a sophisticated string pattern-matching function for analyzing the syntax of user input, and a semiautomated expression builder that helps you assemble script-language commands. You can also create scene backgrounds that serve as reusable templates and draw freeform button-like areas on the screen that, like any other object, can be programmed to

SUITABILITY TO TASK

TourGuide

	POOR	FAIR	GOOD	EXCELLENT
Kiosk creation	N/A			
Runtime creation	●	●	●	○
CBT creation	●	●	●	○

FACT FILE

TourGuide for Windows, Version 1.3

American Training International Inc., 12638 Beatrice St., Los Angeles, CA 90066; 800-955-5284, 310-823-1129; fax, 310-827-1636

List price: $3,370.

Requires: 386-based PC or better, 4MB RAM (8MB recommended), 7MB hard disk space, VGA display or better (256-color Super VGA recommended), DOS 3.1 or later (5.0 recommended), Microsoft Windows 3.1 (Windows-compatible sound card or CD-ROM player for audio playback recommended).

In short: Only the stouthearted professional with good software-development skills should consider TourGuide. It's missing a few key features and could use better documentation, but it has the raw power to create sophisticated applications, if you're not easily intimidated.

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Two Roads to Kiosk Creations

by Luisa Simone

The phrase *multimedia authoring program* is in desperate need of clarification. Traditionally, it has referred to high-powered, high-cost application-development systems that also include CBT functions. But let's face it; many multimedia projects don't require the user-defined variables and direct database access necessary for true CBT applications. Sometimes, kiosks are enough.

Holding the middle ground are two programs that take wildly different approaches to multimedia presentations: HSC Interactive, Version 1.0, (HSC Software, 310-392-8441) and Animation Works Interactive, Version 2.0. (Gold Disk, 800-982-9888). In fact, with the exception of CBT functionality, both of these products meet the selection criteria for this story. They both support conditional branching, can incorporate sound and full-motion video, display animations, and control a laserdisk player.

HSC Interactive, Version 1.0, uses the same flowcharting approach as high-end programs like AimTech Corp.'s IconAuthor. In fact, HSC Interactive is a licensed subset of IconAuthor, so it looks, feels, and to a large degree functions like its high-powered sibling. The similarity of the toolset and a low price of only $295 make HSC a wonderful entry point for aspiring application developers who don't want to commit to IconAuthor's $4,995 price.

The skills that you acquire with HSC Interactive are transferable to IconAuthor. For example, the process of adding content to a presentation is identical in both programs. You simply double-click on one of HSC Interactive's 19 different icons to invoke its associated dialog box, where you can import .BMP, .PCX, or .RLE bitmap images; type and format text strings; or create hot spots.

You'll find that HSC Interactive gives you a great deal of freedom for structuring a presentation. In addition to the true-false path inherent in the flowchart metaphor, you have access to nested loops, exit commands, time-out functions, and conditional branching. It's important to note, however, that HSC Interactive does not support user-defined variables. As a result, you can only build branching routines based upon the value of the current selection area (indicated by hot spot or keystroke) or when a timeout condition has been met. This limitation ultimately has no adverse effect on kiosk presentations because you can easily use these functions to navigate a presentation or to invoke multimedia events.

As we went to press, HSC Interactive did not supply any proprietary drivers for video or audio devices. Version 2.0, which should be available by the time you read this, features drivers for Sony and Pioneer laserdisk players, as well as video-editing features. Therefore, incorporating multimedia events into a presentation requires you to deal directly with MCI commands. To its credit, HSC supplies a truly useful online help file that lists the proper syntax for each command. In addition, the program includes composite icons for CD audio, MIDI, .WAV audio, and video events that basically string together all of the necessary MCI commands. This approach works well for file-based multimedia events, like playing MIDI or .WAV sounds, but be warned: Controlling video devices such as laserdisk players can be an experiment in frustration.

Although HSC Interactive is MCI-compliant, it does not take advantage of other aspects of the Microsoft Windows environment. It is therefore impossible to access other programs through DDE and OLE commands, or via DLL calls. HSC Interactive bundles three ancillary editing programs to help you massage the content of your presentation. Rudimentary paint tools and bitmapped file-conversion functions are provided by the Graphics Editor and the RezSolution utility, respectively; IconAnimate allows you to create basic script-based animations.

At distribution time, you can protect your presentation from accidental changes or editing, but you can't compile the presentation into a single executable file. You'll be thrilled, however, with HSC Interactive's royalty-free runtime player, which allows you to distribute your creations free of charge.

respond to events such as mouse clicks.

What's most impressive is TourGuide's Objectives feature, which provides advanced scoring and performance-analysis functions. It lets you create hierarchies of objectives that can be met by users who correctly answer specific combinations of questions. By defining maps that base their actions on how well users meet these objectives, you can develop self-learning CBT systems that tailor themselves to user performance. This feature played a major role in the CBT development portion of our test suite, and we were surprised by the range of possibilities it can provide an author who has a little imagination.

CLUNKY CREATION

These strengths, however, are offset by several weaknesses. Because TourGuide cannot read .TXT files, the only practical way to enter text is to do it manually, and reading a disk file requires writing a complicated script to input data one block at a time. Furthermore, each text object can only have one set of text attributes. For example, creating a sentence with an italicized word takes two objects. The text editor is primitive and TourGuide doesn't include hypertext or effects like drop shadows, scrolling, or alignment to a curve. Scalable typefaces are available

MAKING MOVIES

Animation Works Interactive, Version 2.0, ($495) proves that there is more than one way to build a multimedia presentation. As a movie-making product, Animation Works relies on frames and not icons to structure a presentation. This approach offers several interesting advantages. First, it allows you to control the sequencing and playback of a presentation very easily. Instead of dealing with if-then statements and multilevel loops, you issue simple GOTO commands using specific frame numbers.

Second, when you work with a frame, you are working with a WYSIWYG view of your presentation, which means you can manipulate backgrounds and cells (called actors) directly. Formatting text, for example, is as simple as selecting a text object and choosing a new font.

Finally, by distinguishing background frames from foreground actors, the program provides a very easy way for the average user to control events. When you assign an event to a frame, execution occurs automatically during playback. For example, you can display a specific background for ten frames and replace it with a new background event on frame number 11. Frame-based events include playback controls such as GOTO commands and playback of a specified segment and a full range of multimedia controls for CD audio, MIDI and .WAV files, and video. You can add interactivity to your presentations by assigning many of these same events to actors—or more properly, to the paths along which actors travel—rather than to the frame itself. For example, clicking on an actor can trigger a GOTO command or initiate an MCI command string.

For the most part, Animation Works does an excellent job of shielding users from MCI commands. The .WAV dialog box contains straightforward check boxes and buttons that let you open, play, and even loop sounds. You can even record .WAV files from within this dialog box, provided, of course, that you have the appropriate hardware installed. Like the .WAV dialog box, the Video dialog box lets you choose a source from a pull-down list of the currently installed devices, set a key color for overlays, and draw a cropping box interactively on-screen. Animation Works also supplies a plain-vanilla MCI window in which you can type commands directly.

Animation Works Interactive provides dialog boxes that attempt to shield the user from MCI commands.

Though Animation Works is not designed for CBT development, you can stretch its functions by invoking other Windows-based programs from within a presentation. And while Animation Works supports OLE, it does so only as a server: You can incorporate movies into OLE client applications, but you can't incorporate other OLE applications into your movies.

Like HSC Interactive, Animation Works provides a free runtime player. Animation Works, however, provides a number of preparatory and playback options. For example, you can run the Accelerator utility to convert standard object-oriented animations into run length encoded (RLE) bitmaps. You can also use the Animation Works Interactive Movie Player to bind your presentations into a single executable file. Gold Disk even supplies an alternative MCI animation driver that allows other applications to play back movies created with Animation Works.

In the final analysis, both HSC Interactive and Animation Works are harbingers of multimedia's future. At less than $300, HSC Interactive proves that multimedia capabilities need not be expensive. And with easy-to-understand dialog box options, Animation Works proves that controlling multimedia devices need not be difficult. □

only in arbitrary fixed sizes, and we found a bug that causes text objects to default to 10-point type whenever you change typefaces.

Creating a runtime version of your application is rather clunky, as well. It entails choosing a menu selection from TourGuide, creating an icon, executing a DOS macro, and then manually moving 800K of .EXE and .DLL files. Although the end result is a royalty-free package that runs quickly under Windows, it may be too large to distribute on a single floppy disk.

TourGuide's deficiencies don't stop there. You can animate any object along an arbitrary path, but it can be cumbersome to edit an object or path after you create it. Synchronizing events requires initializing and sequencing timer objects, a poorly-documented task that we never got to work properly.

TourGuide is a frustrating collection of impressive strengths and surprising weaknesses. If you don't have a software-development background or are primarily interested in developing simple applications, it may not be worth your investment of time and money. Consider this program only if you need to author highly sophisticated systems, already have the necessary programming skills, and think you can live with its limitations. □

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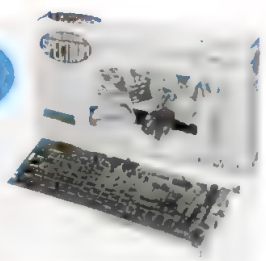

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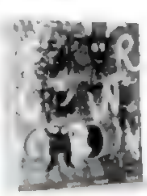

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FIRST LOOKS

HANDS-ON EVALUATIONS OF THE NEWEST NETWORK PRODUCTS

NETWORK MANAGEMENT

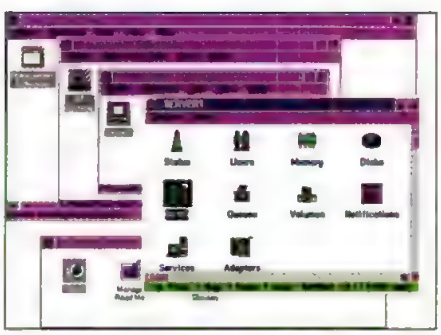
IBM's LAN NetVIEW: The Dark Horse?

BY JEFFREY D. BAHER

IBM's latest entry into the network management arena is like an independent candidate in an election: It shuns the two mainstream environments—Unix and Windows—and allies itself with a powerful system plagued by limited support—OS/2.

Generally, the network management market is thought of as operating within a two-party system. Unix-based platforms are powerful but somewhat complex and intimidating: SunConnect's SunNet Manager, HP OpenView for Unix, and LAN NetVIEW's distant cousin IBM NetVIEW/6000 are all extremely powerful, but the underlying arcane Unix operating system can alienate most inexperienced network managers almost instantly.

On the other side, Windows-based platforms offer easier-to-use—but less powerful—management systems that target the DOS, Windows, and NetWare masses: Novell's NMS and Hewlett-Packard's HP OpenView for Windows provide effective solutions for managing the large population of Intel-based LANs. But Windows has weaknesses, most notably the meager 16-bit, pseudo-multitasking environment itself.



NETWARE STATS: LAN NetVIEW can report on a variety of NetWare server statistics.

LAN NetVIEW attacks the middle ground between those two sides. It is priced to compete with Windows-based solutions but designed for an OS powerful enough to challenge Unix. It runs on OS/2, IBM's 32-bit true multitasking OS. OS/2 provides an acceptable compromise between the ease of use of Windows and the power of Unix. OS/2 does have drawbacks, such as limited market share, limited network adapter support, and a somewhat cryptic user interface (compared to Windows, at least).

LAN NetVIEW's principal compo-

NETWORK EDITION INDEX

First Looks

LAN NetVIEW NE1
Farallon EtherWave adapters NE6
Saber LAN Workstation NE10
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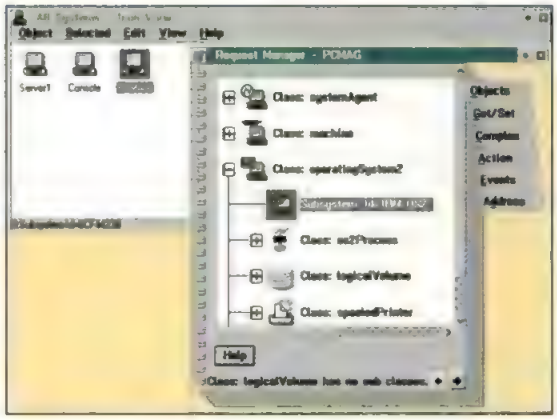
nent is LAN NetVIEW Manage 1.0, which serves as the primary console for event management and topology/discovery services. Manage 1.0 incorporates the View component, which provides graphical views of the network. View also provides map and submap views for IP and IPX devices as well as access to management applications. Manage 1.0 itself includes two utilities: the Request Manager and the Remote Command Line Interface (RCLI). The Request Manager allows the network administrator to query any IBM agents and any other SNMP or Common Management Information Protocol (CMIP, an alternative network management protocol adopted by the ISO) or SNMP agents. Regular "gets" and "sets" can be performed from the Request Manager. The RCLI allows the network administrator to issue commands to remote OS/2 workstations and can be particularly helpful in controlling applications or modifying configuration values.

A variety of agents are also available to enhance Manage 1.0's management capabilities. LAN NetVIEW Agents for DOS includes agents for IBM DOS 5.0 and 6.1, Microsoft DOS 5.0 and 6.0, and Microsoft Windows 3.0 and 3.1. With the agent installed, the network manager can query any DOS or Windows workstations for a wide range of information including system configuration, adapter statistics, and printing information. The LAN NetVIEW Enabler OS/2 agent offers similar information for OS/2 workstations.

To further enhance LAN NetVIEW management capabilities, LAN NetVIEW Agents, Extended Version 1.0, offers management agents for OS/2 LAN Server 3.0, Communications Manager/2 1.0, DB2/2 1.0, and Extended Services for OS/2 Database Manager.



JUST BROWSING: The Request Manager allows you to query network events and other statistics.

LAN NetVIEW also supports a number of IBM add-on applications. Monitor 1.0 provides system performance analysis for OS/2 workstations and servers. Through the Manage 1.0 interface, Monitor can report and graph a variety of performance statistics including CPU, disk, and memory utilization. IBM also offers Fix 1.0, which is designed to receive and process CMIP events and SNMP traps. With Fix the network manager can specify how to handle network events: Fix can store events in a database or display them on the screen. Fix can even dial a pager.

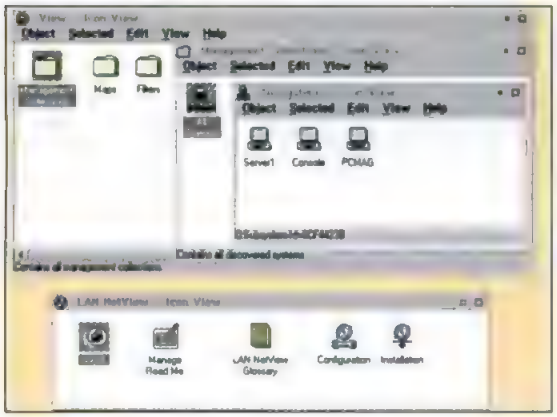
Besides the native IBM applications, LAN NetVIEW is also garnering third-party support. Novell offers NetWare Services Manager (NSM) 1.5, a set of NLMs that permits NetWare server management from the LAN NetVIEW platform. With NSM, LAN NetVIEW can report on a variety of server statistics including server CPU, disk, and memory utilization.

ProTools also offers support for LAN NetVIEW through its Network Analysis Series, which provides distributed network analysis for Ethernet and Token-Ring environments via the RMON MIB. Shany and Microcom have also announced their intentions to support LAN NetVIEW with AlertView and LANlord, respectively. AlertView monitors user applications, while LANlord provides workstation hardware and software inventory, remote workstation monitoring, and software metering.

LAN NetVIEW has also adopted an impressive strategy for distributed network management. Multiple LAN NetVIEW consoles can be distributed throughout a network and still share a common discovery server. Currently, NMS and OpenView for Windows cannot share a common discovery service and thus have to duplicate the process for each console. IBM also offers Tie 1.0, providing integration between LAN NetVIEW and NetVIEW/390, IBM's network management platform for the MVS mainframe environment.

Version 1.0 of LAN NetVIEW has many of the ingredients necessary to make inroads in the network management arena. Especially for existing OS/2 sites, LAN NetVIEW offers a powerful network management solution. Even for mixed environments that include DOS and Windows workstations, NetWare or NetVIEW/390, LAN NetVIEW can provide a solid management platform.

If OS/2 can survive and if LAN NetVIEW can generate more third-party development, especially from internetworking vendors, LAN NetVIEW may very well fight its way to the top. If, however, OS/2 meets its demise and third-party development drops off, LAN NetVIEW's career, like that of so many independent candidates, will be short-lived.



WHAT A VIEW! The View component of Manage 1.0 displays all manageable and discovered network devices.

• List price: *LAN NetVIEW Manage, Version 1.0, $1,839; LAN NetVIEW Enabler, Version 1.0, $89 per node; LAN NetVIEW Agents for DOS, $75 per node; LAN NetVIEW Agents Extended, $75 per node; LAN NetVIEW Monitor, Version 1.0, $795; LAN NetVIEW Fix, Version 1.0, $1,249. (System prices are also available.) IBM Personal Software Products, 11400 Burnet Rd., Austin, TX 78758; 800-342-6672; fax, 512-823-1864.*

Circle 953 on reader service card

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COMPUTERWORLD BUYERS' SATISFACTION SCORECARD August 9, 1993

	Network Archivist 2.0	Cheyenne ARCserve	Maynard Maynstream	Emerald Express Librarian
Data Integrity Reliability	8.7	8.2	7.7	7.2
Automatic Backup	8.7	8.2	7.3	7.4
Security	7.7	7.6	6.6	6.2
Error-Handling	7.5	7.1	6.7	5.9
Complete Restore Time	7.1	7.1	5.9	5.2
Vendor Service	6.8	6.3	6.6	6.2

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Recently, LAN backup users rated backup software on its most important attributes. As you can see, our Network Archivist 2.0 came out on top.

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Network Archivist 3.0 can handle an entire storage hierarchy – from backup to archiving, to file migration – without requiring any additional software. It's all built in!

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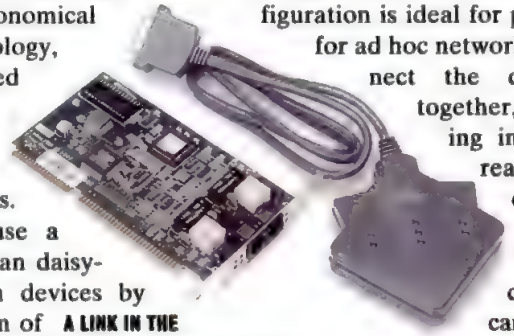
CIRCLE 926 ON READER SERVICE CARD

ETHERNET ADAPTERS

Farallon Simplifies Network Setup

BY JEFFREY D. BAHER

It used to be that each PC in a 10BaseT Ethernet network needed its own connection on a hub. Not anymore. In fact, with Farallon Computing's innovative and economical EtherWave technology, you don't even need to use a hub to build a simple 10BaseT network of up to eight devices. If you want to use a hub, though, you can daisy-chain up to seven devices by using a combination of EtherWave Ethernet cards and transceivers, and you'll only need one hub port.



A LINK IN THE CHAIN: EtherWave lets you connect up to seven devices using only one port on your hub.

Farallon offers EtherWave technology in a variety of products, including the EtherWave ISA Card, an IEEE 802.3–compliant Industry Standard Architecture (ISA) Ethernet adapter with two RJ-45 UTP ports instead of the usual one port. The second port allows the daisy-chaining. It's even easier to daisy-chain than SCSI because you don't have to worry about terminating the chain. Once connected, each computer has complete access to the network, even if some of the machines in the chain are turned off.

Farallon also offers the EtherWave AUI Transceiver so printers or devices with built-in Ethernet support can be chained together. The transceiver has an attachment unit interface (AUI) connector in addition to two RJ-45 UTP connections.

With the EtherWave ISA Card and the AUI Transceiver, a wide range of network devices can be daisy-chained together. To form, for example, an Ethernet environment that comprises a hub, one printer, three PCs, and three Apple Quadra 950s, you would typically need seven hub ports. The use of EtherWave ISA Cards in the PCs and EtherWave AUI Transceivers in the printer and the Quadras allows you to get set up with just one port.

For non-hub environments, the adapters and transceivers support up to eight devices in a chain. This configuration is ideal for peer-to-peer or for ad hoc networks. Simply connect the desired nodes together, and your wiring infrastructure is ready to go. The only limitation is that the eight-node chain you create cannot exceed 100 meters.

The most impressive aspect of Farallon's EtherWave technology is its performance. Results of the NetBench 2.1 NIC Throughput test indicate that the EtherWave ISA Card performed just as well as a performance leader in the ISA Ethernet market—3Com's EtherLink III, Model 3C509, which requires the use of a hub. These results come as no surprise because Farallon implements 3Com's Parallel Tasking technology.

We configured two PCs and a server in a daisy chain using the EtherWave ISA Card and noted the performance of the first and second nodes. The test results of the first and second nodes were almost identical. The card even worked when the first node was left shut off or was shut off in the middle of the test.

Farallon offers EtherWave transceivers and cards for an Apple attachment unit interface (AAUI) as well as NuBus- and LC -compatible Macs. Additionally, Apple PowerBooks, LocalTalk printers, and Newton devices are supported.

Especially for cost-conscious MIS managers, small workgroups with limited hub ports, or small peer-to-peer networks, EtherWave technology offers a simple, effective connectivity solution.

• List price: *Farallon EtherWave ISA Card, $229; Farallon EtherWave AUI Transceiver, $129. Farallon Computing Inc., 240 Mariner Square Loop, Alameda, CA 94501; 510-814-5000; fax, 510-814-5020.*

Circle 952 on reader service card

Benchmark Test: Ethernet Adapters

PC MAGAZINE LABS

Throughout testing, the Farallon EtherWave ISA Card delivered consistently impressive results. As a workstation adapter, it easily matched the performance of the popular 3Com EtherLink III Model 3C509. The test was executed with the machines configured in a daisy chain. The first-node and second-node results were identical.

The test environment included a single Compaq Systempro/XL50 configured as a NetWare 3.12 server. We used two Compaq Deskpro 433/Ms as workstations, each running DOS 5.0 and VLM 1.02 drivers.

The **NIC Throughput** test from ZD Labs' NetBench 2.1 evaluates the amount of data that an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues a series of read requests to a file stored in the server's cache. The test uses block sizes ranging from 64 bytes to 4K.

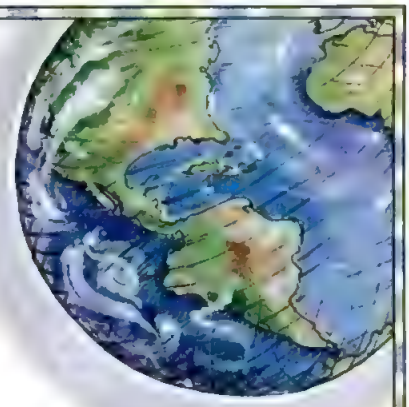
NIC THROUGHPUT

Megabits per second

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
3Com EtherLink III Model 3C509	0.3	0.7	1.2	2.1	3.5	4.8	6.2
Farallon EtherWave ISA Card (first node in daisy chain)	0.3	0.7	1.3	2.2	3.6	4.8	6.2
Farallon EtherWave ISA Card (second node in daisy chain)	0.3	0.7	1.2	2.1	3.5	4.9	6.3

Higher scores represent better performance.

Guess Who's Got The World's Most Popular TCP/IP Network Software For PCs?



If you guessed SunSelect™ and its PC-NFS® networking software, you're right. Every day more companies of all sizes – in the United States, Europe, Asia and beyond – are choosing PC-NFS software to connect PCs to their TCP/IP networks. Because SunSelect is a Sun Microsystems business, these companies know they're getting the product strength and support they need.

With PC-NFS, PC users working with a variety of MS-DOS® and Microsoft® Windows applications can access network resources, share data on company-wide servers and use printers that were previously inaccessible. As a TCP/IP solution, PC-NFS is fully scalable from tens to thousands of users. Each individual user can choose the most appropriate platform for the task at hand. And workers everywhere are able to communicate effectively and get their work done faster.

Successful companies from the Fortune 500 to the shop next door are raving about this popular TCP/IP solution. With the advantages of reduced run-time costs and higher productivity, many companies are able to downsize their network resources. What's more, PC-NFS has received top ratings from both *LAN Magazine* and *InfoWorld*. As well as an endorsement from Microsoft.

Feature-rich PC-NFS includes:

- NFS® and TCP/IP that are fully integrated with MS-DOS and Microsoft Windows;
- Microsoft Windows networking applications such as FTP and Telnet plus on-line Microsoft Windows help;
- Broad application support including Windows Sockets API and NetBIOS applications;
- Enhanced Telnet terminal emulation including VT52-VT320 for DOS and Microsoft Windows;
- Compatible with MS-DOS, Microsoft Windows and Windows for Workgroups;
- NetWare® coexistence – NetWare and PC-NFS clients can coexist on the same PC;
- Add-on applications including SelectMAIL,™ mainframe connectivity products and the PC-NFS Programmer's Toolkit.

TCP/IP is today's fastest growing network protocol. With over a million nodes installed worldwide, PC-NFS software has integrated scores of PCs onto TCP/IP networks, for companies just like yours – with mainframes, minis and workstations. Which means more users are enjoying the convenience of time-saving, transparent access to a variety of resources. And more IS managers are enjoying the peace of mind that comes from a highly productive, efficient and cost-effective network of systems.

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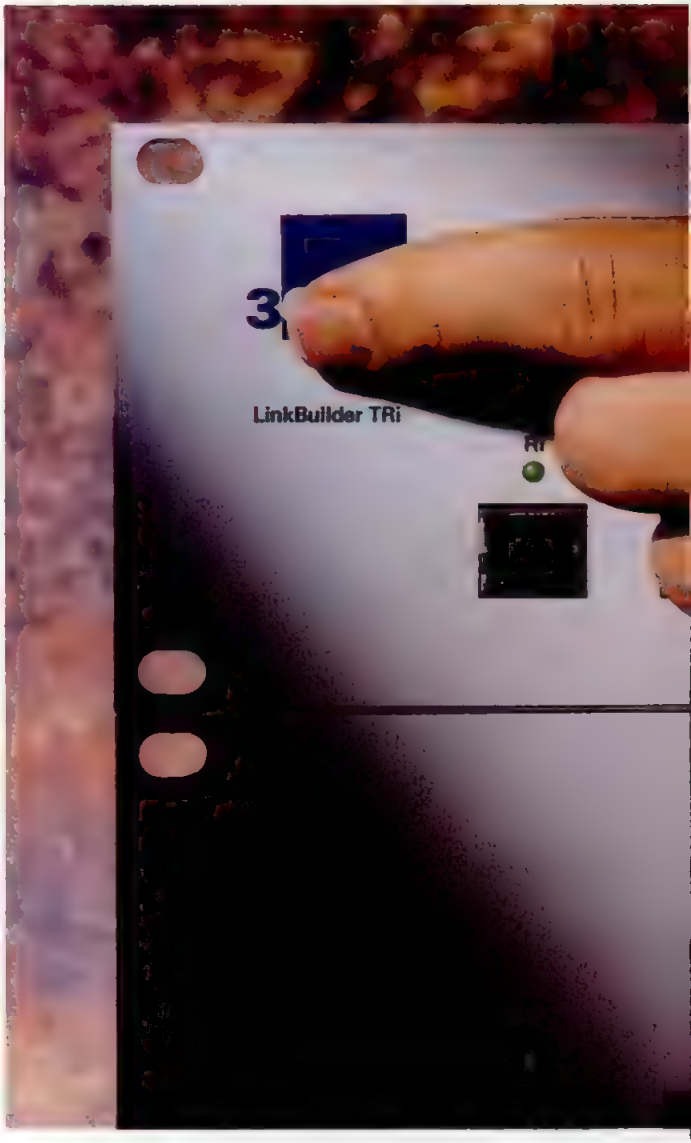
CIRCLE 945 ON READER SERVICE CARD



■ Innovative. Leading-edge. Completely foolproof. These may not be the first words that come to mind about Token Ring networks.

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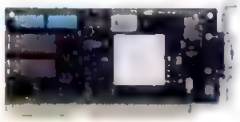
Just look for the products that come with three letters — no, not those three letters, these three letters: 3Com®



3Com's Token Ring solution for the workgroup — including adapters, hubs, and management — improves the performance of your Token Ring network with a series of technological innovations found only with 3Com.

The innovation starts with full network management capabilities for all 3Com TokenLink® III adapters and LinkBuilder® TR Series stackable hubs.

Only 3Com offers fully-implemented RMON for a network analyzer level of management for its Token Ring hubs, providing in-depth troubleshooting tools such as alarms, historical error and traffic analysis, and packet capture with advanced filtering capabilities, among others. No other Token Ring hub offers greater troubleshooting capabilities than 3Com's LinkBuilder TR Series hubs.

Add 3Com adapter management and you can manage down to the desktop to identify and isolate errors on your network, track hardware, and even generate graphical reports.

What's more, 3Com's Phased-Locked Loop technology allows you to carry more robust signals over longer distances with new or existing wires, and will support up to 256 users per ring. And because you can carry clear signals over lower grades of wiring, complete re-wiring of the building is unnecessary.

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3Com's LinkBuilder TR Series hubs even prevent network downtime by locking out faulty users *before* access is gained to the network.

Couple this with the highest-performing, 100 percent IBM®-compatible TokenLink III adapter

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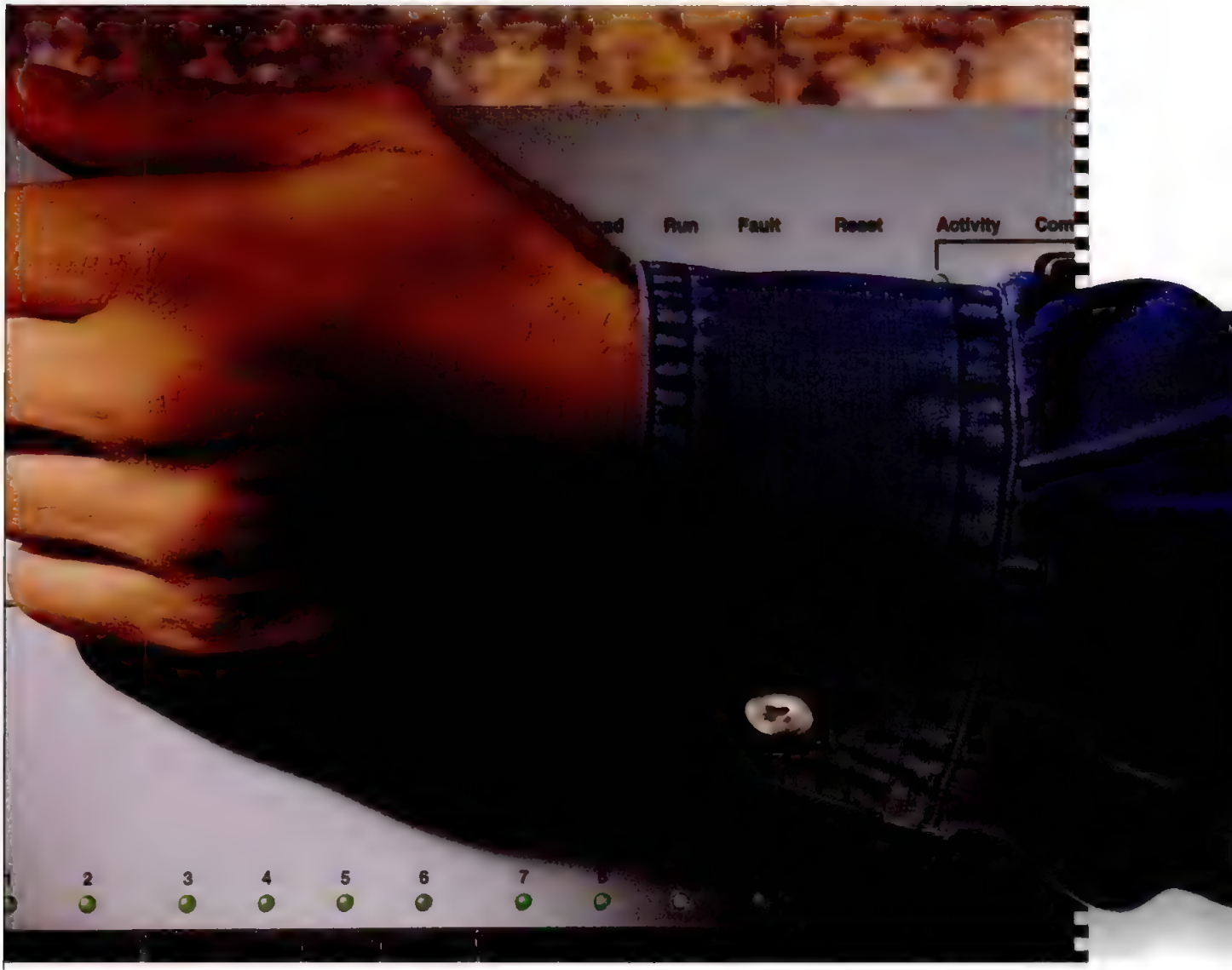

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NETWORK ADMINISTRATION

Saber Offers a Flexible Network Toolkit

BY STEVE RIGNEY

To some people network management means controlling routers and wiring hubs. But to others it means inventorying hardware and software, metering software, and managing network file and print server activities.

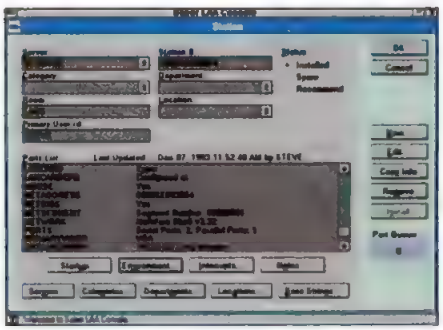
Saber Software Corp. offers an inexpensive and highly flexible package to look after these basic management needs. Saber LAN Workstation, Version 2.0, is a proactive utility for preventing network problems and performing daily network administration.

Saber LAN Workstation retails for a modest $179 (licenses for additional nodes are $39 each), considerably less than some other administrative tools, such as LANovation's LAN Escort. It includes integrated network administrative tools—including DOS and Windows menus—for software and hardware inventory, virus detection, disk space management, security management, and network printer and file management.

Saber Software is best known for its Saber Menu System for DOS. Version 2.0 takes the system and dresses it up for Windows. If you have ever used NetWare's menu program, you know that creating menus for your network can take hours, depending on the number of users and groups. The DOS and Windows menu utility allows you to design a standard menu script and determine the items that will appear on each user's personal menu based on user name, station name, group, and other network information. The utility uses the same menu script for both DOS and Windows menus, so you can create a common script for DOS and Windows clients.

At first glance, Saber LAN Workstation may seem a little intimidating because it has five large manuals and requires around 21MB of disk space for a full installation on the machine that you designate as the Saber LAN Administration Architecture console. It will take you a few days to feel comfortable with this complex product, but fortunately the software offers an attractive and friendly interface.

The most powerful feature of Saber LAN Workstation 2.0 is the SaberBASIC scripting language. SaberBASIC is a Windows-based programming language very similar to Microsoft Visual Basic. You can use SaberBASIC to automate the start-up and control of any Windows-based application and to manipulate the Saber LAN Workstation utilities. For example, you could create a script that would automatically launch the Saber LAN Administration Architecture console, perform a software inventory, and create a report of all software usage during the previous week.



WHAT'S OUT THERE? The inventory utility allows you to track clients' hardware configuration.

You can also use the SaberBASIC program to create Saber LAN Workstation HotSpots: Windows icons that you create to perform specific actions. You could create a fax HotSpot that would automatically fax any file you dragged to it.

Saber LAN Workstation also includes software metering and distribution. Software metering allows you to keep track of your software and insure that your network's software usage does not violate your user licenses. Saber LAN Workstation locks an application after the user license is full. Other software metering programs such as Brightwork's SiteMeter allow you to place users in a queue until a user license is available. Saber LAN Workstation does not currently offer a queue, but it does allow you to see who is currently using the software.

Software distribution, another strong feature, is ideal for updating network drivers and software without visiting each client PC. Saber LAN Workstation allows you to distribute software upgrades automatically to client PCs on the network. In this respect, it is similar to Frye's Software Update and Distribution Software (SUDS).

You can use Saber LAN Workstation to keep an inventory of all of the software and hardware on your network. LAN Workstation provides an inventory program you can run from your login script or from a batch file that can recognize approximately 900 different software applications and hardware information including BIOS version, interrupt settings, CPU, and RAM.

The package also includes other auditing and management functions such as The File Auditor, an 8K TSR that allows you to track how client PCs access files. You can use the File Auditor to monitor every file access on any network client PC. The package includes both a DOS and Windows Print Manager utility. The Print Manager allows you to monitor your NetWare print jobs with the click of a mouse under Windows and a hotkey under DOS.

The Saber Control Panel for Windows is a replacement for the standard Windows Control Panel Program. Network administrators can use the Saber Control Panel to replace the Windows version and disable individual items based on network rights.

There are several products, such as Intel's LANDesk and Symantec's The Norton Administrator, that offer many of the same features as Saber LAN Workstation, including software metering and hardware and software inventory, but Saber LAN Workstation 2.0's unique menu utility and SaberBASIC programming language set it apart. If you need an all-encompassing network administrator toolbox, Saber LAN Workstation is a very good choice.

• List price: *Saber LAN Workstation, Version 2.0, $179. Saber Software Corp., 5944 Luther Ln., #1007, Dallas, TX 75225; 800-338-8754, 214-361-8086; fax, 214-361-1882.*

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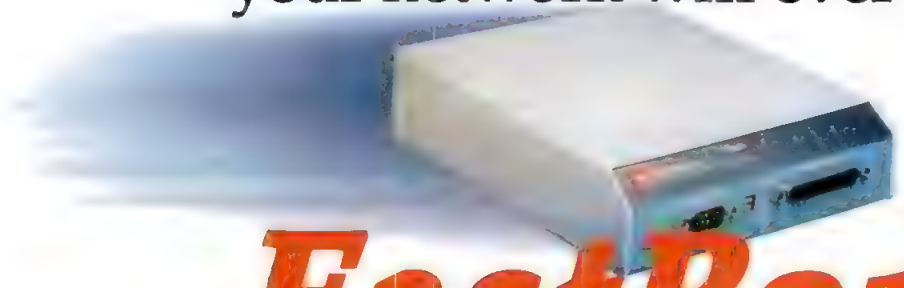

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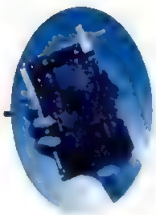

Intel Flash adapters feature Auto Install and Virus Scan, so I get all the control I need.

Are your hands full trying to manage networked PCs? Have you had it with LAN adapter hassles? Then take control with EtherExpress™ Flash adapters from Intel.

Intel **SMART** technology

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NETWORK ADMINISTRATION

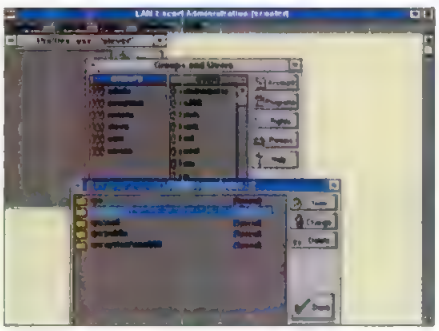
LAN Escort Eases Windows Management

BY STEVE RIGNEY

The chore of managing your Windows desktop is often like a bad dream, but managing 100 or more Windows-based network clients can be a nightmare. LANovation's LAN Escort, Version 3.0, is designed to relieve the pain of managing and updating all of your Windows client PCs. LAN Escort, though relatively expensive, provides an easy-to-use administrative tool that replaces NetWare's DOS-based Syscon administrative program, which can be cumbersome, time-consuming, and inflexible.

LAN Escort is designed specifically for Microsoft Windows 3.1 clients on NetWare networks. It allows you to set up all of your network users and groups, distribute your Windows applications, and manage Windows on both individual client PCs and a NetWare file server.

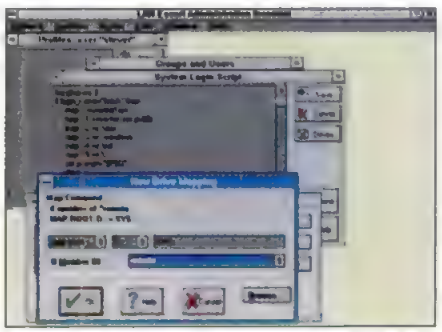
Other network administration products such as Saber Software's LAN Workstation offer software and hardware inventory, metering, and software distribution in addition to basic Windows management, but LAN Escort is the only one specifically designed to manage networked Windows-based PCs. Compared with other administration utilities, which require a lot of disk space and include several manuals, LAN Escort is easy to install, easy to use, and easy to understand.



WINDOWS ON NETWARE: LAN Escort offers a Windows interface for NetWare administration.

LAN Escort requires Windows 3.1 or later and NetWare 3.*x*. (It supports NetWare 4.*x* only using bindery emulation, but LANovation plans to support Novell's NetWare Directory Services in a future release.) LANovation offers a comprehensive technical assistance package, which includes a special Preinstallation System Assurance phone call to walk users through the installation.

One of the most useful tools of the LAN Escort program is the Windows-based NetWare administration utility. Every NetWare administrator is familiar with Novell's DOS-based Syscon utility and knows that it can take hours to set up all of the users, groups, and trustee rights. Syscon does not allow you to print out a detailed report showing a list of your users and limits you to viewing either group information or user information, not both at one time. The administration utility offers an easy-to-use GUI that, in effect, is Syscon for Windows.



CENTRAL CONTROL: The Windows GUI simplifies mapping drives and editing login scripts.

The Administration program allows you to create or delete users and groups, assign home directories, edit trustee information, map network drives, and edit your system login script. Assigning a user to a group is as simple as dragging the user icon to the desired group. You can also use the program to enable or change passwords and edit login times and days. If you have a 100- to 200-node network, the Syscon replacement utility is worth the price of the program solely on the time it will save.

While LAN Escort is a great tool for managing NetWare users and groups, that's only half of the program's power. LAN Escort was designed to help you manage Windows running over the network. When you run Windows on a large network, you have to contend with individual desktops and applications. Not all users want or need the same applications, and everyone wants to customize their Windows color scheme. Customizing every Windows PC on a large network is a time-consuming process.

LAN Escort allows you to customize individual Windows PCs from a central station so that installing an application to a client is only a matter of dragging the application icon to the user icon. LAN Escort will make the correct changes to the user's .INI file and place the application icon on their desktop. You can also create a list of each user's applications. LAN Escort also provides a print manager that you can use to set up network printers for Windows.

Not all network administrators choose to load Windows on each client, so you can also use LAN Escort to manage clients running Windows from the server.

LAN Escort is not an administrative cure-all. If you need to gather hardware and software inventory or software metering and distribution, LAN Escort is not the solution for you. However, if you need to manage a large network of Windows-based PCs and easily access NetWare user information, LAN Escort offers a good—but expensive—solution.

• List price: *LAN Escort, Version 3.0, $995. LANovation, 1313 5th St. SE, Minneapolis, MN 55414; 800-747-4487, 612-379-3805.*

Circle 951 on reader service card

CORRECTIONS AND AMPLIFICATIONS

In our First Looks review of Brightwork Development's SiteMeter software metering utility (December 21, 1993, page NE32), we incorrectly reported that Funk Software's AppMeter requires a TSR on the client PCs and alters executable files, while SiteMeter does not. In fact, AppMeter does require a TSR on the client PCs and actually creates dummy files rather than modifying existing ones.

Becky Weinberg,
Technical Writer,
Microcom

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"...the closest thing to having remote control built into Windows itself."
—Windows Magazine

Over a million people rely on Microcom's Carbon Copy for fast, effortless remote access. No other program makes it so simple to be on your office PC or LAN anytime you're away from the office.

Traveling professionals use Carbon Copy to send and retrieve files, and check e-mail. Branch office personnel and telecommuters use it to access vital data on corporate LANs. While support specialists use it to assist both LAN-based and remote users, saving time on both ends.

Our newest version makes remote computing in Windows a breeze, with faster screen updates than any other program, when running applications. Also, data compression speeds up file transfer—for big savings in time and phone charges.

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Microcom's Carbon Copy for Windows: the first remote control software that doesn't make you feel remote. What a great idea.

Now for just $49, upgrade to Carbon Copy for Windows version 2.0

Upgrade from any remote control software, including any version of Carbon Copy. To order, phone 1-800-765-1750.

30-Day No-Risk Guarantee

Try Carbon Copy for Windows version 2.0 for 30 days at absolutely no risk. If you're not fully satisfied, return it for a refund.

For free information on Carbon Copy and the name of your local Microcom dealer, phone **1-800-822-8224**

Microcom offers a complete suite of remote access products.

Only Microcom provides such a wide range of remote access products and capabilities. They include a full line of high-speed desktop and portable modems; Microcom Bridge/Routers™ (MBR™) for remote internetworking; and High Density Management Systems™ (HDMS™) for dial-up networks. Call for details.

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CIRCLE 862 ON READER SERVICE CARD

NEW & IMPROVED

NEWS OF ANNOUNCED NETWORK PRODUCTS AND UPGRADES

NEW

Tut Systems Offers Inexpensive Peer-to-Peer LAN

As the cost and complexity of cabling decreases, peer-to-peer networking becomes a more practical solution for connecting small and remote offices. Enter Tut Systems—the first company to provide a peer-to-peer solution that can run Novell's NetWare and Personal NetWare, Microsoft's Windows for Workgroups, Artisoft's LANtastic, and Unix over regular telephone wire. The Silver Streak line of connectors and converters can be connected via telephone wire to form an Ethernet LAN running at 10 Mbps. Using the connectors, up to 30 nodes can be daisy-chained over a distance of 185 meters.

FAST AND EASY: Runs at 10 Mbps over regular telephone wire.

The product family consists of the Silver Streak AUI/AAUI Connectors; the Silver Streak ISA, NuBus, and LC Solutions; the Silver Streak 10BaseT Converter; and the Silver Streak Single UTP Converter. Assembling a network is as easy as connecting a Silver Streak Connector to the AUI or AAUI port of a PC, Macintosh, or workstation.

• List price: *Silver Streak AUI/AAUI Connectors, $99; Silver Streak ISA Solution, $199; Silver Streak NuBus/LC Solution, $249; Silver Streak 10BaseT Converter, $199; Silver Streak Single UTP Converter, $99. Tut Systems Inc., 2446 Estand Way, Pleasant Hill, CA 94523; 800-998-4888, 510-682-6510; fax, 510-682-4125.*

Circle 954 on reader service card

NEW

Kalpana's EtherSwitch Sports Fault Tolerance

If switches are going to serve as the high-speed connections between servers and clients, they best be reliable, which is why Kalpana has added fault tolerance to its EtherSwitch line of switches. The Kalpana Fault Tolerant EtherSwitch (FTES) protects against network downtime and consists of two 15-port EtherSwitch EPS-1500 units that operate in parallel with mirrored port-by-port connections to hubs, servers, and other network nodes. When connected via serial cable to a VT100 terminal, one FTES unit is operational and the other tests the operational unit and itself. It automatically detects failures and switches over operations from the primary EtherSwitch to a standby unit. If a failure occurs, Kalpana claims, the secondary unit will take over operations in 2 to 3 seconds, all the while maintaining client/server connections and eliminating the need to reestablish connections to servers. Another model is available, featuring dual load-sharing power supplies to protect against power failures.

• List price: *Kalpana Fault Tolerant EtherSwitch, $7,500; with dual power supplies, $9,500. Kalpana Inc., 1154 East Arques Ave., Sunnyvale, CA 94086-4602; 408-749-1600; fax, 408-749-1690.*

Circle 955 on reader service card

HOT PROSPECT

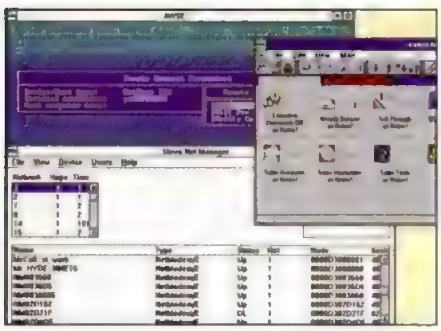
3Com Doubles Port Density

3Com's new LinkBuilder FMS TP stackable hub addresses items on every network manager's most-wanted list: growth, manageability, media flexibility, and cost effectiveness. The Ethernet hub offers 24 twisted-pair ports, twice the number of ports available from its predecessor. It also features an AUI port and a transceiver interface slot. A stack of a maximum of four hubs yields 104 ports. Management is provided via a slide-in module, Transcend LinkBuilder FMS Manager for Windows, based on 3Com's Transcend applications. The module supports local, TELNET, and SNMP management and provides a hierarchical view of the network. The hub offers flexibility in its cabling, providing connections over twisted-pair, coaxial, or fiber Ethernet cable. The hub is aggressively priced at only $103 per managed port and $71 per unmanaged port—18 to 38 percent less than many competing products.

• List price: *3Com LinkBuilder FMS TP, $1,695; 3Com LinkBuilder FMS Management Module, $780; Transcend LinkBuilder FMS Manager for Windows, $495. 3Com Corp., 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052-8145; 408-764-5000.*

Circle 961 on reader service card

Shiva Adds Remote Control to NetModem/E



VERSATILE: Provides users with both dial-in and dial-out capabilities.

Remote node or remote control—does it matter? Well, instead of having to choose, now you can have both with Shiva's NetModem/E, Version 1.5. Shiva has added remote control capabilities to this latest release, providing users with both dial-in and dial-out capabilities. The capabilities come via Symantec Corp., which has agreed to bundle its Norton pcAnywhere remote-control software with Version 1.5 of NetModem/E.

With the addition of the new software, NetModem/E will provide users with complete access to network resources using either remote-node or remote-control technology. The remote-node software in NetModem/E allows remote users to dial in over standard phone lines, connect to a NetWare, AppleTalk, or Microsoft Windows for Workgroups 3.1 network, and operate as a remote node on the network. When users connect through NetModem/E's IPX dial-in or network-to-network routing features, they can run the pcAnywhere software for remote-control access to specific applications such as flat-file databases. The dial-out feature also lets users dial out to on-line services such as CompuServe and Nexus. Current NetModem/E users can purchase the upgrade kit for only $75.

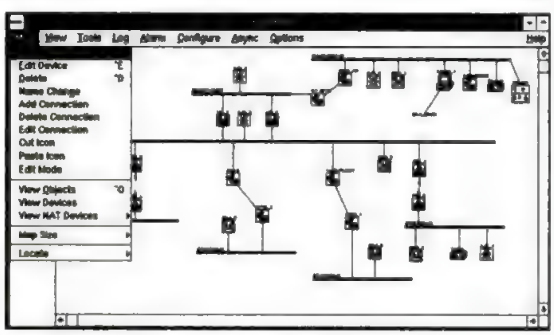
• List price: *Shiva NetModem/E, Version 1.5, $1,699. Shiva Corp., Northwest Park, 63 Third Ave., Burlington, MA 01803; 800-458-3550, 617-270-8300; fax, 617-270-8852.*

Circle 956 on reader service card

IMPROVED

NAT Upgrades Its RMON Support

You can never have enough information. At least that's what Network Application Technology seems to think. The company's latest version of its network management package, NMS/100, can now more effectively monitor and analyze Ethernet networks, thanks to additional support for the remote monitoring management information base (RMON MIB) standard. The RMON MIB is a proposed SNMP standard for monitoring and analyzing network traffic.



ADDED RMON: Facilitates monitoring an Ethernet network.

Version 3.0 features extended RMON functions including New Node Discovery, IP-to-Ethernet Address Mapping, and Duplicate Address Detection capabilities. In addition, the package's upgrade also provides support for the dynamic data exchange interface for Microsoft Windows, which allows a network manager to export data gathered using both SNMP and RMON to databases and spreadsheets to aid in analysis and network planning. NAT has also added support for the Windows Sockets specification, allowing NMS to be used with third-party Windows TCP/IP applications.

• List price: *NMS/100, Version 3.0, $2,495. Network Application Technology Inc., 1686 Dell Ave., Campbell, CA 95008; 408-370-4300; fax, 408-370-4222.*

Circle 957 on reader service card

BRIEFS

ADAPTERS

Socket Communications unveiled PageCard ($495), a dual-mode wireless messaging device with a PCMCIA interface. PageCard operates as a standalone LCD alphanumeric pager. And when it is combined with messaging software for Microsoft Windows, PageCard can interface with popular e-mail, scheduling, spreadsheet, and word processing software. 510-670-0300.

Thomas-Conrad Corp. reduced the price of its Type II PCMCIA Ethernet LAN adapter, the TC5041, by up to 27 percent. The TC5041 comes in two versions: Ethernet 10BaseT ($235) and 10Base2 ($262). It ships with drivers for ODI- and NDIS-compliant networks. The drivers support access to major network operating systems, including NetWare, LAN Manager, and LAN Server. 800-332-8683, 512-836-1935.

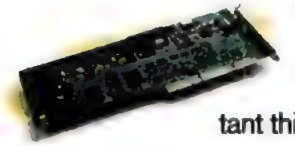
PRINT SERVERS

Digital Products, a leading supplier of network printing products, expanded its family of VINES print servers with the addition of NETPrint/50 and NETPrint/150. NETPrint/50 ($595) connects a single parallel-port printer to a VINES 10BaseT Ethernet network. NETPrint/150 ($1,345 to $1,595) connects up to four parallel-port printers to a VINES Ethernet or Token-Ring network. 800-243-2333, 617-647-1234.

Axis Communications added advanced SNMP support to its Axis NPS 550 Ethernet print server ($695). The enhanced SNMP support allows users to monitor their network printers as well as other devices on the network that incorporate SNMP support, such as routers and bridges. 508-777-7957; fax, 508-777-9905.

Tap into higher throughput, without tapping out your CPU.

Introducing The TC4047. The Highest Performance Token Ring EISA Adapter On The Market.



Your CPU has a lot on its mind. And frankly, it has more important things to do than deal with a slow token ring adapter. That's why we developed the TC4047, an EISA adapter that offers both the highest throughput and the lowest CPU utilization available.

Thanks to its PacketBlaster™ LAN accelerator, the TC4047 gives you maximum throughput, without tying up your host system's CPU.

How? Each TC4047 literally has a mind of its own — an 80186 microprocessor dedicated to managing data flow. So your CPU has a lot less to think about. The TC4047 runs at less than 10% CPU utilization.* Lower than any other EISA adapter. Which makes it ideal for servers — even those requiring multiple adapters for added scalability.

The TC4047 offers unbeatable price/performance in its class, as well as the best service and support. In fact, free tech support from our Certified Novell Engineers is available all day, all night, all year round.

So call Thomas-Conrad today for more information on the TC4047 EISA adapter, and our full line of award winning token ring products. With performance like this, it's really a no-brainer.

1-800-332-8683

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CIRCLE 857 ON READER SERVICE CARD

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*Based on testing performed at 2KB and 4KB file sizes.

The secret HP, Compaq and Lexmark were hoping we wouldn't tell.

Take a close look at their page printers and you'll see: you spend your really big money on disposable printer cartridges.

One HP® LaserJet® 4Si, for example, in a high-volume* network printing environment could easily run up $4,183 in cartridge bills in its first year alone — more than the price of the printer itself. Five Compaq® Pagemarq™ 15s could cost you $22,193 in cartridges. And a year's worth of cartridges for ten Lexmark™ IBM® 4039 16L printers would probably set you back by about $41,611.

If you had no choice, these numbers would simply represent the cost of doing business. But the fact is, you do have a choice.

Cartridge-Free printing

Kyocera® is in the printer business, not the cartridge business. That's why we were free to develop Ecosys® Cartridge-Free printing. And why you can print up to 7,000 pages with an Ecosys printer with a single $49 no-mess Ecotone® toner refill.

In our high-volume network printing example, choosing an 18-ppm Ecosys FS-3500A over an HP LaserJet 4Si would save you $2,797 a year. Five FS-3500As would save you $15,263 compared with the Compaq solution, while ten FS-3500As would save $27,751 over Lexmark in just one year.

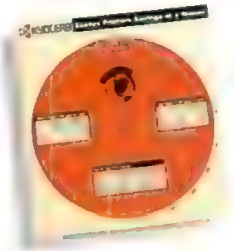
Best of all, you wouldn't give anything up. You'd get consistently high output quality, fast throughput, reliability and full network compatibility.

Cartridge-Free for consistent quality

The traditional laser printer uses disposable cartridges because the traditional drum built into them wears out fast. The Ecosys drum doesn't. Its durable amorphous silicon (a-Si) surface will last a fully-warranted three years/300,000 pages and beyond. Plus, Ecotone toner has ceramic particles to polish and recondition the drum with every page you print. The result for you is consistently clean output over the lifetime of the printer.

So what's the secret?

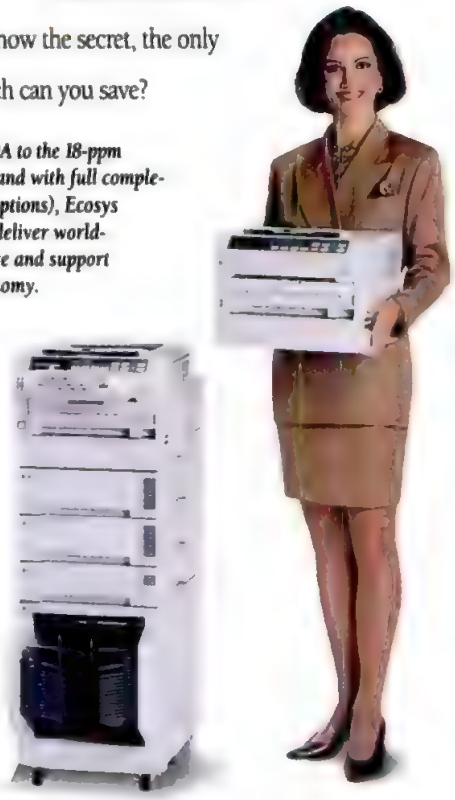
It's this: to evaluate a printing solution, you've got to consider cost of printing. And for networks with one to 1,000 printers, Ecosys Cartridge-Free printing is inherently more economical — by a wide margin.



How wide? The free Ecosys savings-at-a-glance calculator wheel will help you find out. For yours, or additional information on the Ecosys printer family, call **1-800-2-ECOSYS.**

Now that you know the secret, the only question is, how much can you save?

From the 10-ppm FS-1500A to the 18-ppm FS-3500A (shown alone and with full complement of paper handling options), Ecosys Cartridge-Free printers deliver world-class quality, performance and support with unprecedented economy.



KYOCERA

TECHNOLOGY WITH A CONSCIENCE.

*All comparisons based on InfoCorp values. 5% average page coverage. "high-volume" = 16,500 pages/month. Retail prices (8/93)/InfoCorp yields used for calculations. HP 4Si cartridge—$169/8,000 pages. Compaq 15 cartridge—$269/12,000 pages. Lexmark 16L cartridge—$269/12,800 pages. To calculate: Cartridge price ÷ yield at 5% = cost per page. cost-per-page x total annual volume = annual cartridge expense.

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CIRCLE 869 ON READER SERVICE CARD

NEW

ODS Announces Hub-of-Hubs Module for Switching, Analysis

Optical Data Systems announced a module that offers per-port switching and per-port protocol analysis on a single card. The 1094-SBTFL module will come with 12 or 24 10BaseT copper ports and four 10BaseFL fiber ports and provide both per-port switching and per-port protocol analysis. Per-port switching allows the network manager to assign users, regardless of their physical location, to any Ethernet segment. It also allows the network manager to distribute users over several servers in order to maintain performance levels. Per-port protocol analysis provides the network manager with access to low-level packets of information based on the nine groups of the RMON SNMP standard.

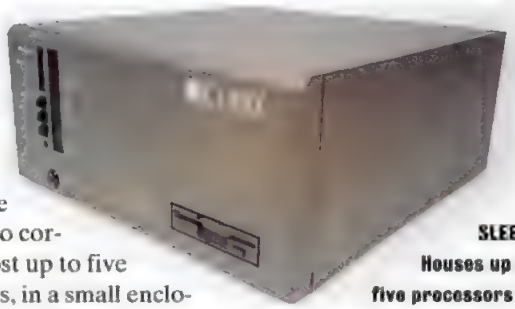
• List price: *ODS 1094-SBTFL: $5,400 (12-port), $9,600 (24-port). Optical Data Systems Inc., 1101 E. Arapaho Rd., Richardson, TX 75081; 214-234-6400; fax, 214-234-1467.*

Circle 958 on reader service card

NEW

Cubix Connects Branch Offices with BOS

Cubix Corp. has brought a scaled-down version of its fault-tolerant Enhanced Resource Subsystem communications server, the ERS/FT, into the remote-office arena. The Branch Office System 100 (BOS 100) server provides network managers with the ability to connect branch offices to corporate networks. BOS 100 can host up to five processors from different locations, in a small enclosure. The ERS/FT can host up to eight. Cubix has integrated its Intelligent Environmental Sensor, a monitoring and remote-processing control device that provides network managers with SNMP-compliant information regarding the BOS 100's internal temperature, fan rotation, power supply voltages, and processor activity. The BOS 100 is available with a 3.5-inch floppy disk drive (Model 110), 5.25- and 3.5-inch floppy disk drives (Model 120), or a CD-ROM drive (Model 130).



SLEEK: Houses up to five processors in a small enclosure.

• List price: *Cubix Branch Office System 100: Model 110, $1,195; Model 120, $1,295; Model 130, $1,995. Cubix Corp., 2800 Lockheed Way, Carson City, NV 89706; 702-883-7611; fax, 702-882-2407.*

Circle 959 on reader service card

NEW

SunConnect and NetLabs Announce Development Pact

There's a new kid on the network-management block, and its name is DiMons* 3G (formerly NetLabs/OverLord). SunConnect has announced that it will support the NetLabs platform. The two companies have made a cooperative agreement outlining separate paths toward a common goal—a shared, distributed network management environment. Each company is committed to adopting and maintaining common application programming interfaces, console interoperability protocols, and information models.

• *SunConnect, 2550 Garcia Ave., Mountain View, CA 94043; 415-960-1300. NetLabs Inc., 4920 El Camino Real, Los Altos, CA 94022; 415-961-9500.*

Circle 963 on reader service card

BRIEFS

BUSINESS NEWS

3Com Corp., announced its acquisition of Synernetics, a manufacturer of Ethernet and FDDI switches. 3Com will purchase the company, a development partner since 1991, for an estimated $104 million. Synernetics will remain in its current location, Massachusetts, and become 3Com's switching division. 3Com, 408-764-5000; Synernetics, 508-670-1814.

Intel Corp. announced the formation of a strategic partnership with SynOptics Communications. The companies will develop and market interoperable 10/100-Mbps Ethernet products. By combining adapter cards from Intel with switching hubs from SynOptics, the companies hope to provide a path to high-speed Ethernet networking while allowing network managers to preserve existing network wiring investments. Intel, 800-538-3373; SynOptics, 408-988-5525.

Cabletron Systems joined the Fast Ethernet Alliance, a group of networking companies that create specifications for 100-Mbps carrier sense multiple access with collision detection (CSMA/CD) Ethernet technology. The Alliance's focus is to provide wiring specs, allowing network managers to choose between Category 3, 4, or 5 unshielded twisted-pair; Type 1 shielded twisted-pair; and fiber-optic cable. 603-332-9400.

Tandem Computers and **Ungermann-Bass** aim to reduce client/server application crashes with a series of products called NonStop Access for Networking, including a new dual-port LAN adapter called MasterLAN FT and Tandem NonStop Himalaya servers with paired LAN connections. Tandem, 408-285-6000; UB, 408-496-0111.

Our high-volume printing solutions are packed with these 2,000 exciting features.

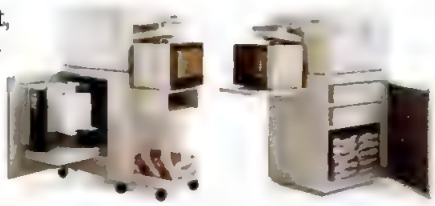
More paper going in.
The HP Paper Feeder raises your input capacity to a whopping 2,000 sheets.

More paper coming out.
The HP Output Stacker lets you print all 2,000 pages before picking up a single document.

More paper nearby.
The HP LaserJet Printer Cabinet holds your printer, paper feeder, supplies, and—you guessed it—reams and reams of paper.

There's nothing terribly exciting about stacks of paper. Except that Hewlett-Packard's paper-handling solutions for the HP LaserJet III Si, 4Si and 4Si MX printers let you spend a lot less time dealing with them. And when it comes right down to it, why *save time* with a 17-page-per-minute printer if you have to *spend more time* putting paper in and taking documents out?

The 1,500-sheet HP Paper Feeder and HP LaserJet Printer Cabinet give network users double the input capacity plus a place to keep paper — where it won't get wrinkled or dog-eared.



For unattended printing, use the HP Paper Feeder with the 2,000-sheet HP Output Stacker*. It's the ideal solution for printing big jobs after hours.

If increasing productivity sounds more exciting than refilling paper trays, talk to your HP representative or reseller. Or call 1-800-752-0900, ext. 7889 for more information.

HEWLETT® PACKARD

*Installation is required by HP authorized service personnel. © Hewlett-Packard Company 1993

CIRCLE 942 ON READER SERVICE CARD

THE EXPANDABLE, RELIABLE, ECONOMICAL, FAULT-TOLERANT DISK ARRAYS

RAIDION LT and LS Series disk array subsystems are designed for use with either Novell NetWare 3.1x/4.x or IBM OS/2.

MIRROR RAIDION can be configured with 2 modules to provide mirrored fault tolerance up to 3 GB.

RAID 5 Adding one module to a mirrored subsystem and installing RAIDWARE™, doubles the user capacity by converting the mirrored array to RAID 5. Under OS/2, the maximum configuration is 28 modules. Under NetWare, RAIDION can be expanded to 32 modules per array with a capacity of 93 GB.

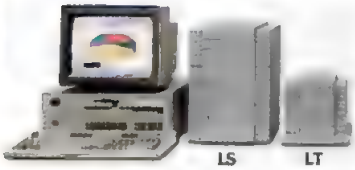
Exceptional Warranty Micropolis offers a full five year parts and labor warranty on its entire line of high-capacity disk drives. Other RAIDION subsystem components have a one year warranty.

Reliable RAIDION can be configured with an on-line spare module that activates automatically upon a drive failure, ensuring continued fault-tolerant operation without human intervention. Hot-Swap and Hot Replacement features allow RAIDION to be serviced while your network remains in operation.

Award Winning In a benchmark comparison of arrays, Corporate Computing said: "*Raidion was our overall winner with an impressive combination of high performance, low cost, and unparalleled expandability.*" May 1993. RAIDION was also named LAN Magazine's Disk Array Product of the Year for 1994.

Economical An LT Series three module 2 GB array is only $6,585. An LS Series Raid 5 array with a capacity of 6 GB lists for $12,825. That's just $2.12 per MB. It's no wonder Byte Magazine said: "RAIDION's *low price alone makes it worth considering.*" August 1992

RAIDION LT can be stacked up to seven modules high for convenient desk top use.



MODULE #	CAPACITY	DRIVE FORM
LM 1050	1,050 MB	LT 3.5-inch
LM 1760	1,760 MB	LT 3.5-inch
RM 2100	2,100 MB	LS 5.25-inch
RM 3020	3,020 MB	LS 5.25-inch

Other add-on module capacities available.

For the name of the reseller nearest you, call toll free 1-800-395-3748.

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CIRCLE 914 ON READER SERVICE CARD

DigiBoard Is Your Best Connection To Remote LANs.

DigiBoard brings remote LANs closer together. Whether you have an outside salesforce that needs access to data, road-bound executives that need their E-MAIL, or satellite offices that need to communicate on a regular basis, DigiBoard can help you make the connection. Anywhere in the corporate network. Anywhere in the world.

Wherever There's a Phone Line... You Can Extend Your LAN.

DigiBoard remote communication products install easily and provide high-speed connectivity through standard or digital (ISDN) phone lines. In fact, you can choose from a wide variety of products and connect over 1000 users through a single server without degrading performance. With DigiBoard, anywhere there's a phone line you can extend the corporate LAN.

DigiBoard Makes Your World a Little Smaller and a Lot More Profitable.

As your world gets smaller, DigiBoard's intelligent serial boards can help make it more profitable. With an onboard front-end processor, these boards off-load processing requirements from your host CPU. This keeps host performance high while eliminating data loss caused by host interrupts. And our unique architecture provides transmission speeds faster than standard serial ports. This reduces transmission time and lowers phone bills. All of which keeps performance high, overhead low, and saves you time and money.

High Speed Ports for Remote Access

DigiBoard provides a range of connectivity solutions from adding a single user to creating a corporate communications hub. Choose from intelligent serial ports (asynchronous for standard or synchronous for X.25 communications) and ISDN products.

Here's How You Make the Right Connection.

Just call DigiBoard for a FREE pocket guide. Ask for either The Pocket Guide to Extended LAN Access Solutions or The Pocket Guide to ISDN LAN Extensions. Or talk to a product specialist for additional information.

Call 1-800-551-4797

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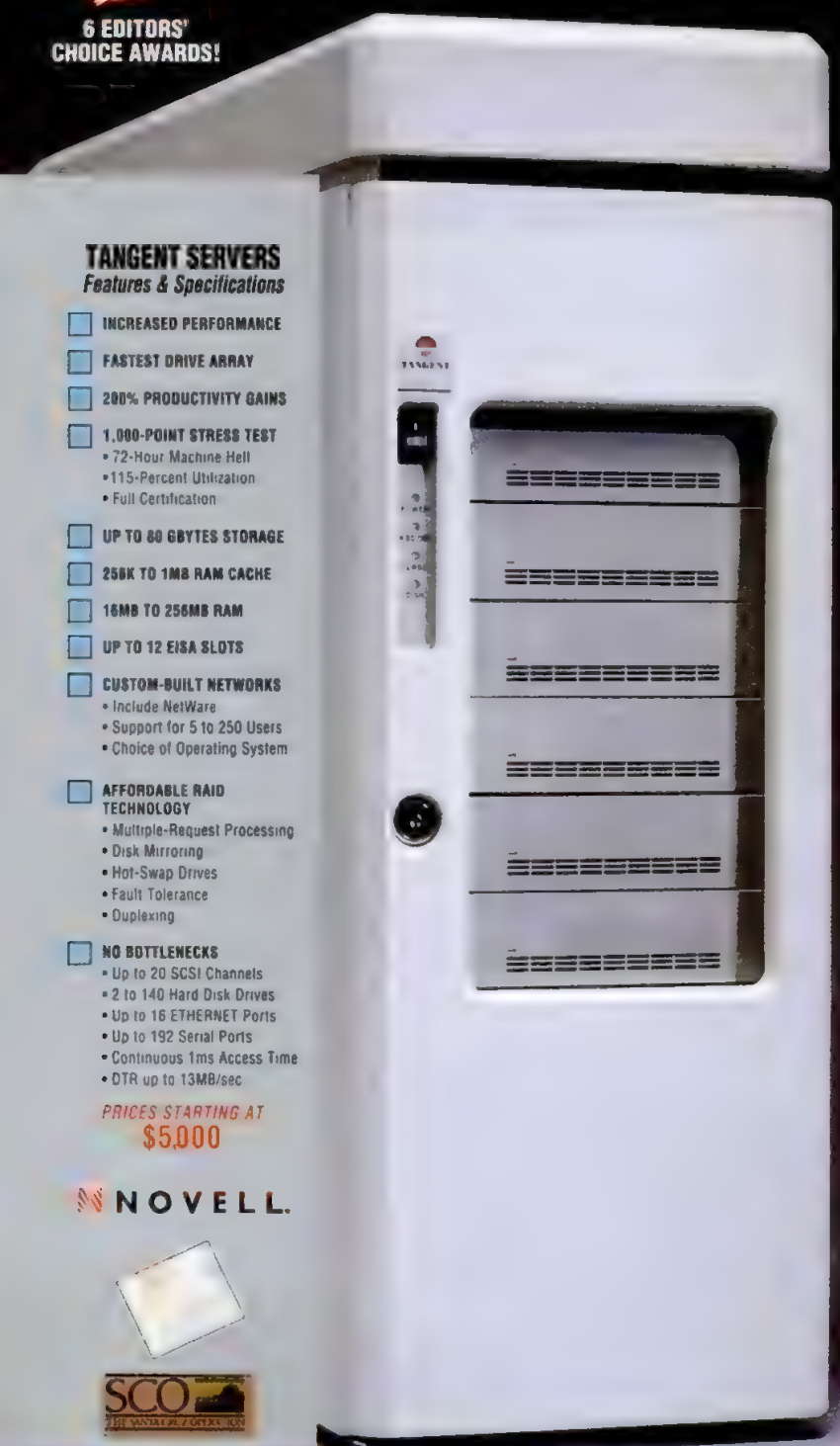
CIRCLE 854 ON READER SERVICE CARD

WORLD CLASS SERVER
FIRST CLASS SERVICE

6 EDITORS' CHOICE AWARDS!



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  - 72-Hour Machine Hell
  - 115-Percent Utilization
  - Full Certification
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- ☐ 16MB TO 256MB RAM
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  - Duplexing
- ☐ NO BOTTLENECKS
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  - 2 to 140 Hard Disk Drives
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  - Up to 192 Serial Ports
  - Continuous 1ms Access Time
  - DTR up to 13MB/sec

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$5,000

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WE'VE OUT-CLASSED THE COMPETITION!

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PC MAGAZINE, FEBRUARY 11, 1992

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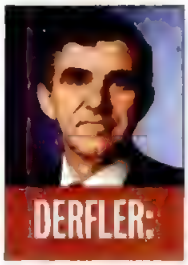
Searching for the Paperless Office

David, I'm discouraged. Despite all the talk of the "paperless office," most computer systems still produce a lot of paper. At this time last year, I had great hope that a category of programs called "forms routing" software would change that by changing how people work. And last year's products such as Delrina's FormFlow and WordPerfect's InForms still hold great promise: They should eliminate paper and smooth the flow of office work. But when? Our lives are still as full of printed forms as ever, but now those forms are spewed from a computer-driven line printer in triplicate instead of being typed on a sheaf with two pieces of carbon paper.



I have a feeling that electronic document exchange software, which allows users to view documents on-line without the application in which they were created, is going to take me on the same roller coaster ride. Programs such as Adobe's Acrobat, Farallon's Replica, and No Hands Software's Common Ground distribute documents, speed editing through annotations, and allow searches through millions of words in milliseconds—giving access to entire libraries of documentation. Sounds alluring, doesn't it?

Electronic document exchange technology has three pitfalls—only one of which is avoidable.

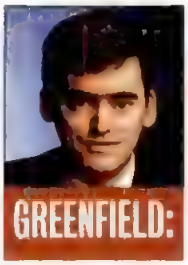
But it has three pitfalls—the need to implement strategically, the need to print, and the load it places on the network—only one of which is avoidable. First, to be successful, these packages must be widely deployed: You need to spread the investment out as much as possible. The costs of changing the network infrastructure (calling for more bandwidth), training, and the program itself are so great that deployment on a small scale is too expensive.

Second, nothing is as portable as a piece of paper. You might need more networked printers in convenient locations than you would if you kept traditional paper libraries.

Third, the need for strategic implementation means that the programs must be networked, and the load they place on servers, file systems, backup systems, and media access control schemes is tremendous. Despite some compression, these programs use huge files, and servers must process multiple requests from many clients.

I was enthused about forms routing, and the promise of electronic document exchange has much of the same appeal, but will I be fooled twice?

Frank, you're downplaying the benefits and worrying too much about the drawbacks. Electronic documents may not replace paper ones, but their usefulness cannot be understated. Using electronic document exchange technology, you can display documents containing graphics, charts, and text at any station on the network without the expense and mess of printing them out. Plus, you can update documents and distribute them immediately without delivery delays.



Probably the best thing about electronic media is that it's instantaneous. A messenger may take hours and express delivery services may take a day, but you can deliver electronic documents yourself as soon as you finish editing them. Frank, we often need to turn around page proofs in one day, and our coworkers are spread across the country. Our fax machine here in New York just doesn't have resolution high enough to transmit and receive the complex graphics we use. That's why when Gail, our associate editor of networking, needs approval of final pages from Rob and John, our lab guys in California, only electronic documents get the job done.

A messenger may take a day, but you can deliver these documents as soon as you finish editing them.

You're concerned about large documents, but hypertext links make finding information faster and simpler. Yeah, I know—not everyone wants to bother with setting them up, but even without them, you can search a file, which is a lot more than what you can do with paper.

Sure, the technology's not perfect. I agree that providing the bandwidth it requires may become a real problem (though the 500K files it uses are not impossibly large for today's networks). But on many of today's networks there is still plenty of bandwidth. And when you need more, you'll be able to turn to the new high-speed LAN standards. Claiming a lack of bandwidth, I say, is a poor excuse for not innovating.

No, you can't edit these documents on the receiving end, and that's the next step I'd like to see these companies take, but being able to copy data is real helpful. Keeping documents electronic means that you can easily reuse text.

Will electronic document exchange replace paper? Of course not. But if you need to share or ensure timely delivery of common information such as a central telephone directory or employee handbooks (and we all do), they are the best choice around.

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yes
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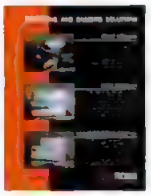

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PC Tech

Take a look inside ODBC, Microsoft's new standard for database connectivity. This issue's Corporate Developer shows you what ODBC is, how it works, and how to use it to your advantage in writing multi-platform database applications.

User-to-User

BY NEIL J. RUBENKING

Using Copy And Paste in Dialog Boxes

Some Windows programs don't have an Edit menu for copy and paste, and even in those that do, the menu isn't available when a dialog box is open. So I assumed that Clipboard operations were not available in dialog boxes. But I've discovered what seems to be an undocumented means of accessing Windows' copy and paste capabilities.

When I experimented with the shortcut keys for copy (Ctrl-Ins) and paste (Shift-Ins), I found that they work for dialog box text. This saves time and eliminates typing errors when entering data. By using these key sequences, you can rapidly fill in complicated lines of text in a dialog box without having to memorize or jot down the entry. Suppose, for example, you're creating a .PIF file for a program that needs a long pathname for its start-up directory. You can copy the path name directly from the Properties dialog box in Program Manager into the PIF Editor dialog box.

In the newest releases of Microsoft programs, the keyboard shortcuts for copy and paste are Ctrl-C and Ctrl-V. Both sets of keys work within dialog boxes but not in all programs. For example, Ctrl-V is a toggle view command in Ami Pro. Usually I stick with the Ctrl-Ins and Shift-Ins keys.

Bill Bennet
North Olmsted, Ohio

▶PC MAGAZINE: The text boxes you find in Windows dialog boxes are standard controls supplied by Windows itself. Support for both sets of Clipboard action keystrokes is built into the standard text box, so unless a particular program overrides this behavior, you should be able to copy and paste text in any dialog box. Once this has been pointed out, it seems obvious, but I've found that many users don't know about it.

You can also cut text from one dialog-box line and paste it into another. This is handy if you've accidentally filled in the wrong line (for example, putting the command line into the description line of Program Manager File Properties). The old keyboard shortcut for cut is Shift-Del; the new shortcut is Ctrl-X (the X is supposed to resemble scissors).

The new shortcut keystrokes are consistent with those used on the Macintosh. Microsoft recommends that all applications support them, and that users make a habit of using *only* the new keystrokes. This suggests the possibility that the old shortcuts may be phased out at some point, so you'd do well to start using the new ones exclusively.

Dating Your Journal Entries

The computer readily lends itself to making notes of things you've done and those that need to be done. These memorandums are more useful when they are dated and kept in a running file, such as a journal or a diary. However, the output of the DATE command clutters

DATER.SCR

Complete Listing

```
e 0100  BA 60 01 B4 09 CD 21 B4
e 0108  2A CD 21 51 52 B4 00 BB
e 0110  0A 00 88 F0 E8 26 00 E8
e 0118  3C 00 5A 88 D0 B4 00 E8
e 0120  1B 00 E8 31 00 58 E8 14
e 0128  00 BA 60 01 B4 09 CD 21
e 0130  BA 77 01 CD 21 B4 2A CD
e 0138  21 B4 4C CD 21 B9 00 00
e 0140  41 31 D2 F7 F3 52 1D 00
e 0148  00 75 F5 5A 80 C2 30 B4
e 0150  02 CD 21 E2 F6 C3 B4 02
e 0158  B2 2F B9 01 00 CD 21 C3
e 0160  20 22 22 22 22 22 22 22
e 0168  22 22 22 22 22 22 22 22
e 0170  22 22 22 22 22 20 24 0D
e 0178  0A 24
n DATER.COM
RCX
7A
W
Q
```

Figure 1: **DATER.COM, produced by this DEBUG script, writes a nicely formatted line containing the current date.**

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MEMODAY.BAT
Complete Listing

```
@ECHO OFF
DATER  >> JOURNAL.TXT
FOR %%R in (0 1 2 3 4 5 6) DO IF ERRORLEVEL %%R GOTO k%%R
:k0
ECHO                        (Sunday) >> JOURNAL.TXT
GOTO end
:k1
ECHO                        (Monday) >> JOURNAL.TXT
GOTO end
:k2
ECHO                        (Tuesday) >> JOURNAL.TXT
GOTO end
:k3
ECHO                        (Wednesday) >> JOURNAL.TXT
GOTO end
:k4
ECHO                        (Thursday) >> JOURNAL.TXT
GOTO end
:k5
ECHO                        (Friday) >> JOURNAL.TXT
GOTO end
:k6
ECHO                        (Saturday) >> JOURNAL.TXT
:end
ECHO Type your message  -  use Ctrl-Z and Enter to end it.
COPY JOURNAL.TXT+CON > NUL
MORE < JOURNAL.TXT
```

***Figure 2:* MEMODAY.BAT adds the day of the week to your memos using the exit code from DATER.COM.**

the file with messages like

```
Current date is Fri 05-28-1993
Enter new date (mm-dd-yy):
```

The DATE command also requires that you press Enter or type in a new date to continue. Further, it doesn't separate the memorandums well.

If you redirect the script listed in Figure 1 into DEBUG with the command DEBUG < DATER.SCR, you'll create DATER.COM. This program writes the date, neatly placed at the center of a separating line. In addition, it returns a number signifying the day of the week in its exit code.

The batch file MEMOS.BAT,

```
@ECHO OFF
DATER >> JOURNAL.TXT
ECHO Type your message  -use
ECHO Ctrl-Z and Enter to end it.
COPY JOURNAL.TXT+CON > NUL
CLS
MORE < JOURNAL.TXT
```

shows how easy it is to record memorandums using DATER with COPY CON. MEMODAY.BAT (Figure 2) also records the day of the week, obtained from DATER's exit code, using the ERRORLEVEL test. The last line of each batch file displays the entire contents of the journal file. If this becomes a nuisance, you can delete that line.

B. W. Shumway
Silver Spring, Maryland

▶PC MAGAZINE: Though DATER is a good idea, I don't really approve of DEBUG scripts like the one in Figure 1. Why? Because it's simply a collection of bytes, conveying no information about how or why it works. You can use it, but you can't learn anything from it! For those who want to use and understand this program, I wrote the script shown in Figure 3. The program it produces is not the same as the original DATER.COM but serves the same purpose.

The program begins with a subroutine that you may want to use in your own

DATER2.SCR
Complete Listing

```
N DATER.COM
A 100
JMP 114         ; jump to start of main program
          ;=============================================
          ; begin number-storing subroutine
          ;   AX contains number to be stored
          ;   ES:DI points to LAST digit of buffer
          ;   direction flag must be set (reverse)
          ;=============================================
MOV CX,0A       ; put 10 (for base 10) in CX
                ; store:
XOR DX,DX       ; clear DX
DIV CX          ; divide AX by 10
XCHG DX,AX      ; swap DX (remainder) and AX (quotient)
ADD AL,30       ; convert remainder to a digit
STOSB           ; store it
XCHG DX,AX      ; re-swap DX and AX
CMP AX,0        ; reduced AX to 0?
JNZ 105         ; if not, store another digit
RET
     ;=============================================
     ; end number-printing subroutines.
     ;=============================================
STD             ; set direction flag (reverse)
MOV AH, 2A      ; select get date function
INT 21          ; call DOS interrupt
PUSH AX         ; save AX (holds day of week)
PUSH DX         ; save DX (holds month and day)
PUSH CX         ; save CX (now holds year)
          ; store the year value
POP AX          ; get year in AX
MOV DI,164      ; *** point to end of year in string
CALL 102,       ; call store
          ; store the day value
POP AX          ; get month/day in AX
PUSH AX         ; re-save month/day
SUB AH,AH       ; clear high byte from day value in AX
MOV DI,15F      ; *** point to end of day in string
CALL 102        ; call store
          ; store the month value
POP AX          ; get month/day in AX
XCHG AH,AL      ; swap month into AL
SUB AH,AH       ; clear high byte from month value in AX
MOV DI,15C      ; *** point to end of month in string
CALL 102        ; call store
          ; print the result
MOV AH,09       ; choose display string function
MOV DX,145      ; point to the string
INT 21          ; call DOS interrupt
CLD             ; clear direction flag (forward)
          ; set exit code to day of week
POP AX          ; restore day of week
MOV AH,4C       ; select exit with return code function
INT 21          ; call DOS interrupt
DB ' ******************** 00/00/0000'
DB ' ******************** ' 0D 0A '$'

RCX
7E
W
Q
```

***Figure 3:* For those who want to *understand* as well as use DATER.COM, this highly commented DEBUG script produces an alternative version of the program.**

small programs. This subroutine takes a numeric value in the AX register and converts that value into a string of decimal digits. It stores the digits in the memory address pointed to by ES:DI; it stores them, however, from right to left. Before you call this subroutine, the direction flag must be set using the STD instruction, and ES:DI must initially point to the *end* of the buffer that will hold the string of digits.

The DATER program gets the current day, month, year, and day of week by calling DOS function 2Ah. DATER calls the subroutine to store the year, day, and month values in a buffer located at the end of the program. Since the buffer

DATER2.SCR adds the date to your documents and explains in detail how this is done.

is initialized with the value 00/00/0000, single-digit day or month values are automatically stored with a leading 0. When the buffer is filled in, the program calls DOS function 09h to print it. The subroutine then terminates using DOS function 4Ch to set its exit code to the day of week value.

You can edit the two DB lines at the end of the program to use different separator characters. For example, these two lines would give you a separator made of dashes and asterisks:

```
DB ' *-*-*-*-*-*-*-*-*-*-*-
 00/00/0000'
DB ' -*-*-*-*-*-*-*-*-*-*-* '
 0D 0A '$'
```

Don't change the length of either line or the position of the date in the line unless you're comfortable enough with DEBUG script programming to recalculate the size of the program and the address of each of the three parts of the date.

You can download all the files mentioned in this column from PC MagNet's Utilities/Tips Forum archived as DATER.ZIP. □

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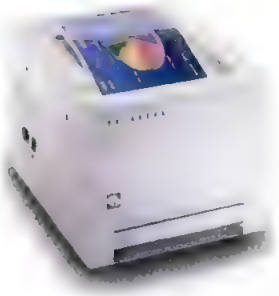

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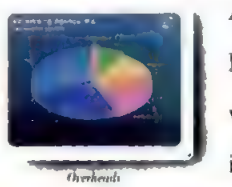

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CIRCLE 001 ON READER SERVICE CARD

Tutor

BY JEFF PROSISE

How Accelerator Boards Speed Up Windows

There are several things you can do to make Windows run faster—add RAM to your system, replace your old hard disk with a faster hard disk, use disk-caching software to make the disk work faster, and so on. But of all the things that you can do to speed up Windows, few have the performance-boosting potential that replacing your old video adapter with a video board accelerated for Windows does. Windows accelerator boards (or just Windows accelerators, for short) make Windows run faster by making screen operations faster. When screen operations speed up, Windows speeds up too, because so many of the everyday procedures that users perform in Windows are pixel-intensive. Actions such as moving a window from one location to another, dragging an icon across the screen, or scrolling around in a word processing document are all very data- and computation-intensive. Standard-PC architectures (non–local bus) are not optimized for getting pixel information to the screen quickly, so PC performance suffers in a graphical operating environment unless specialized hardware is present to lend a hand.

It's clear that Windows accelerators are of enormous benefit to the average system. A typical Windows accelerator offers a two- to threefold speed advantage over a standard, unaccelerated VGA board. But it's less clear to most users how Windows accelerators work—how dropping a $200 video board into an old PC can deliver such a dramatic performance increase. Here is the lowdown on how Windows accelerators perform their magic, and why it makes so much sense for Windows users to install accelerated video cards in lieu of standard, unaccelerated video cards.

SO MANY PIXELS, SO LITTLE TIME Windows accelerators come in several varieties. Some, like the popular Diamond Stealth Pro and the Actix Graphics-Engine Ultra (an Editors' Choice award winner in "Waking Up Windows," *PC Magazine*, April 13, 1993), use fixed-function accelerator chips to boost Windows' graphics performance. Both of these boards use the fast 86C928 chip from S3 Corp., as do a handful of other boards from other vendors. Fixed-function chips are not programmable but are preprogrammed with a variety of graphics primitives (shapes, such as lines, circles, and rectangles, which can be manipulated as one item) that video drivers may call upon. Some boards, such as those from ATI Technologies and Compaq, use proprietary fixed-function accelerator chips. Still others use programmable graphics coprocessors, such as the Texas Instruments TMS34020, which, like the microprocessors that drive PCs, can be programmed to suit particular needs and purposes. (For example, boards based on programmable graphics coprocessors sometimes outperform fixed-function boards when running CAD applications, because the boards can be reprogrammed for optimized CAD operation.) Regardless of what chip or chip set a board uses, the aim of every accelerator is the same: to speed Windows by performing common graphics operations in specialized hardware rather than in software.

Here's the lowdown on how Windows accelerators perform their magic, and why it makes sense for Windows users to install accelerated video cards.

The graphics coprocessors used in Windows accelerators speed graphics operations the way math coprocessors speed floating-point operations: by relieving the CPU of work. All video boards, whether they're accelerated for Windows or not, require a *video driver*—a program that controls all interactions with the display—to work with Windows. The video driver used with an accelerator card hands routine graphics operations off to the accelerator rather than performing them itself in the CPU. The graphics hardware on-board the accelerator performs these operations faster and frees the CPU to continue running the program that initiated the graphics operation. Pixel manipulations proceed from start to finish in less time, and the entire program runs faster because the CPU's work load is sharply reduced.

Certain graphics operations are performed over and over in Windows: bit-block transfers (commonly referred to as BitBlts—the name of the associated Windows function), line draws, and pattern fills, among others. To initiate a drawing operation, a program calls a function, such as BitBlt or LineTo, from Windows' GDI (Graphics Device Interface) module. The GDI in turn places a call to the Windows video driver. When the video driver accompanying an unaccelerated video card receives a call from the GDI, it performs any necessary computations itself, using the CPU, and moves bits to

VIDTEST.C

Complete Listing

```
/*
 *  VIDTEST uses Windows' BitBlt and LineTo functions to move a block of
 *  pixels laterally across the screen.
 */

#include <windows.h>
#include "vidtest.h"

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG);

/*
 *  Function WinMain.
 */

int PASCAL WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
{
    static char szAppName[] = "VidTest";
    WNDCLASS wndclass;
    HWND hwnd;
    MSG msg;

    if (!hPrevInstance) {
        wndclass.style = 0;
        wndclass.lpfnWndProc = (WNDPROC) WndProc;
        wndclass.cbClsExtra = 0;
        wndclass.cbWndExtra = 0;
        wndclass.hInstance = hInstance;
        wndclass.hIcon = LoadIcon (NULL, IDI_APPLICATION);
        wndclass.hCursor = LoadCursor (NULL, IDC_ARROW);
        wndclass.hbrBackground = NULL;
        wndclass.lpszMenuName = szAppName;
        wndclass.lpszClassName = szAppName;

        RegisterClass (&wndclass);
    }

    hwnd = CreateWindow (szAppName, szAppName, WS_OVERLAPPEDWINDOW,
        16, 16, GetSystemMetrics (SM_CXSCREEN) - 32,
        GetSystemMetrics (SM_CYSCREEN) >> 2, HWND_DESKTOP,
        NULL, hInstance, NULL);

    ShowWindow (hwnd, nCmdShow);
    UpdateWindow (hwnd);

    while (GetMessage (&msg, NULL, 0, 0)) {
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }
    return msg.wParam;
}
```

```
/*
 * WndProc processes messages to the main window.
 */

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
{
    HDC hdc;
    RECT rect;
    int nWidth, nCount, i;

    switch (message) {

    case WM_COMMAND:

        switch (wParam) {

        case IDM_START:
            EnableMenuItem (GetMenu (hwnd), IDM_START, MF_GRAYED);
            hdc = GetDC (hwnd);
            SelectObject (hdc, GetStockObject (BLACK_PEN));

            GetClientRect (hwnd, &rect);
            rect.left = rect.right >> 1;
            FillRect (hdc, &rect, GetStockObject (BLACK_BRUSH));

            GetClientRect (hwnd, &rect);
            nWidth = rect.right >> 1;
            nCount = rect.right - nWidth;

            for (i=0; i<nCount; i++) {
                BitBlt (hdc, i + 1, 0, nWidth, rect.bottom, hdc, i, 0,
                    SRCCOPY);
                MoveTo (hdc, i, 0);
                LineTo (hdc, i, rect.bottom);
            }

            ReleaseDC (hwnd, hdc);
            return 0;

        case IDM_EXIT:
            SendMessage (hwnd, WM_CLOSE, 0, 0L);
            return 0;
        }
        break;
    }
    return DefWindowProc (hwnd, message, wParam, lParam);
}
```

Figure 1: **This short C program shows you the difference in performance between a Windows-accelerated graphics board and a standard video card.**

and from the video buffer to update the image on the screen. (The video buffer is an area of memory where the screen image is stored.) With this type of driver, the CPU is tied up for the duration of the call.

By contrast, a video driver accompanying an accelerator board passes many of the GDI calls it receives to the accelerator. The accelerator handles the operation internally and frees the CPU to carry on with its business. In most cases, the CPU can proceed immediately, without waiting on a signal from the accelerator that the operation is complete. Some GDI calls, such as line draws and pattern fills, correspond neatly to graphics primitives supported in the hardware and are passed almost directly to the accelerator hardware. Other, more complex operations are broken down into two or more graphics primitives and passed to the accelerator one primitive at a time. Most Windows accelerators support a first in, first out (FIFO) buffer in which several pending graphics operations can be queued. In either case, the CPU ends up doing only a fraction of the work it would normally do, and performance is enhanced.

The reduced work load on the CPU is one reason that Windows accelerators boost performance. Another is that the accelerator can manipulate bits in the video buffer a lot faster than the CPU can. Suppose you're using a PC with a VGA card installed in a 16-bit ISA bus. To transfer a 256- by 256-pixel block on a 256-color screen, the video driver must read and write a minimum of 65,536 bytes. If the CPU performs the transfer, the data is transferred 16 bits at a time over the bus. Accelerator chips typically use a wider internal bus (64 bits in the case of ATI's Mach 32 chip), so data is moved in larger chunks without involving the PC's data bus. And once again, the CPU becomes free sooner, because its responsibility effectively ends once the driver can pass the call to the accelerator.

Local-bus video takes a similar approach of increasing the bandwidth of video data transfers. By providing a wide, dedicated data path between the CPU and the video board, a local bus speeds the transfer of bits. A local bus has little effect, however, if data-intensive graphics functions are handled by the accelerator and not by the CPU. That's why you may not realize much of a performance increase if you combine local-bus video and a Windows accelerator in the same system.

Built-in graphics primitives and wider internal data paths account for most of the speed that accelerators lend to Win-

dows but not for all of it. Most accelerators feature additional optimizations designed to enhance video performance even further. Most perform a service called *bitmap caching*, in which blocks of pixels that are being manipulated are cached in unused regions of video memory. A 1,024- by 768-pixel Windows screen displaying 256 colors requires only 768K of video memory. If your video board contains 1MB of RAM, that leaves 256K available for bitmap caching. A smart driver can take advantage of this memory to improve video performance.

Most accelerators also implement a *hardware cursor*, in which the accelerator assumes the responsibility for redrawing the mouse pointer as it moves about the screen. Once again, this frees up the CPU to carry on more important tasks. Finally, most accelerators use either fast, dual-ported VRAM, or video RAM, for on-board video memory (as opposed to DRAM, or dynamic RAM, which is slower but less expensive) or an optimized DRAM configuration that provides fast, VRAM-like memory accesses.

EXPERIENCE THE DIFFERENCE If you want to see the speed difference between accelerated and unaccelerated video boards firsthand, check out the short demonstration program in Figure 1. Written in Microsoft C, VIDTEST.C is available for downloading from Library 3 of PC MagNet's Utilities/Tips Forum, archived as VIDTES.ZIP, which also contains its companion files, VIDTEST.MAK (the make file), VIDTEST.DEF (the module-definition file), VIDTEST.H (the header file), VIDTEST.RC (the resource script), and VIDTEST.EXE (the compiled executable).

VIDTEST uses a series of BitBlt and LineTo calls to move a rectangular block of pixels laterally across the screen. When you select Start from the Options menu, VIDTEST measures the length and width of its window and blacks out the right half. Then it sets nCount equal to the number of pixels that the image in the left half of the window will be moved horizontally and moves the image a pixel at a time with the following loop:

```
for (i=0; i<nCount; i++) {
    BitBlt (hdc, i+1, 0, nWidth,
     rect.bottom, hdc, i, 0,
     SRCCOPY);
    MoveTo (hdc, i, 0);
    LineTo (hdc, i, rect.bottom);
}
```

On each iteration through the loop, BitBlt copies the image to a new destination a pixel to the right of its current location. Then LineTo draws a 1-pixel-wide black line down the left side to erase the remnants of the old image. BitBlt and LineTo functions are processed internally by nearly all accelerators, so one would expect to see the pixel block move noticeably faster on an accelerated video board than on a standard VGA. If you have a Windows accelerator installed in your PC, run VIDTEST once using the driver that goes with your video board. Then use Windows Setup to switch to a conventional VGA driver and run VIDTEST again, and note the difference. The VGA driver handles BitBlts and LineTos in software, so the graphics accelerator doesn't get utilized even though it's present in the system.

Drivers are closely tied to the architecture of the board, and a poorly written driver can slow down even the fastest accelerator.

This demonstration also shows how important a role the video driver plays in the interaction between Windows and accelerated video hardware. The driver is closely tied to the architecture of the board, and a poorly written driver can slow down even the fastest accelerator. That's one reason some board manufacturers continually turn out revised versions of their drivers, and why the performance of different boards using the same accelerator hardware varies—sometimes significantly. Video drivers are complicated programs, and minor tweaks to their code sometimes produce real performance enhancements. □

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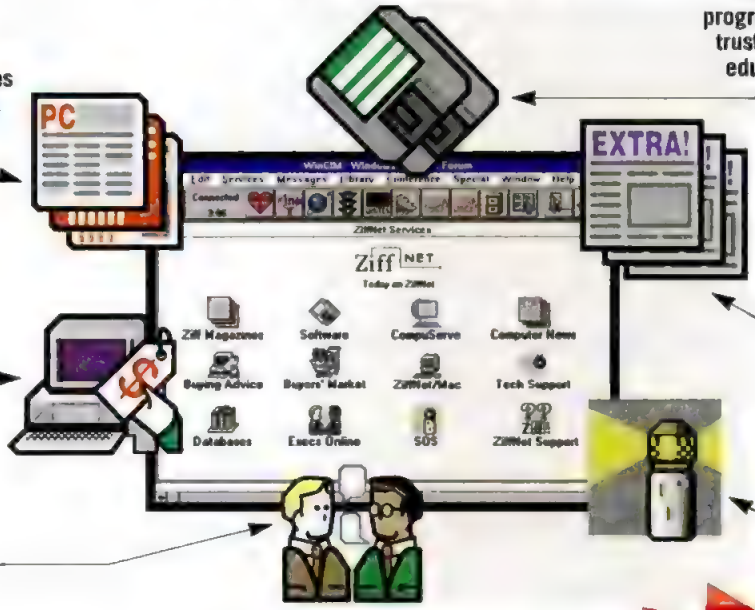

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CIRCLE 385 ON READER SERVICE CARD

Corporate Developer

BY RICHARD HALE SHAW

A New Standard for Database Connectivity

Picture this: You're creating an important database application. You carefully design the application, investigate different options for database management systems, and begin to design the application's tables when it hits you: It's commitment time and suddenly you're locked into a single database management system.

Committing to a particular database management system (DBMS) means that you're stuck with its database language or API (application programming interface). Once you've selected a database manager, you have to live within its limits. Often that means you won't be able to read or write files created by other database managers directly or access files maintained by SQL DBMSs across a network. At best, you'll be able to use data import and export, provided your DBMS offers import and export facilities for the type of files you want to access. And if you ever have to move your application's data to another platform or configure it for a new network, you might be out of luck. Even modifying the application to use database tables that reside on a different network or drive can be a major hassle.

Fortunately, there's hope: Microsoft's Open Database Connectivity (ODBC), a standard for accessing data in a variety of relational and nonrelational DBMSs. In this column, I'll explain what ODBC is, how it works, and how you can use it to your advantage in writing multiplatform database applications. And I'll briefly describe several approaches for bringing ODBC to your Windows applications.

WHY ODBC? ODBC is a new standard for accessing data in a variety of DBMSs. Based on the SQL Access Group Call Level Interface (CLI) specification, ODBC specifies a single API for concurrently accessing, viewing, and modifying any number of different database tables. Before ODBC, multiplatform database applications were usually limited to accessing a single DBMS, database language (or API), or database at a time. For instance, if your Xbase application needed access to Paradox or Oracle tables, you were limited to your DBMS's import/export capabilities, and if you needed to access mainframe-based DB2 tables via SQL, you might be out of luck. And if the tables were moved or relocated to another device, drive, or directory, you would, at minimum, have to modify an application-specific configuration file. In any case, you were locked into using the technology provided by a single database vendor, and the only solution was to learn multiple APIs or database languages and the idiosyncrasies of multiple DBMSs.

ODBC allows an application to use a single API for simultaneously accessing any number of different databases in different locations.

ODBC was designed to alleviate most of these problems. The ODBC API lets an application use a single API for simultaneously accessing any number of different databases (*data sources* in ODBC lingo) in different locations. Your application isn't tied to an underlying network or DBMS, so it's insulated from changes to the database manager, network transports, and server mechanisms. Because ODBC is implemented on multiple platforms, your applications will be portable (with respect to their use of ODBC) to those platforms.

There's only one hitch: Before you can access data, you must have a driver for that type of data source. But for those supported platforms, you can create applications that use the same API to access Xbase, Paradox, SQL, ASCII text, and other file formats (such as Microsoft Excel worksheets or Oracle tables) in a variety of locations (local, network, or mainframe).

THE DEVELOPER'S PERSPECTIVE ODBC guarantees a minimum functionality that lets you connect to a supported data source, send it a command via the ODBC API or embedded SQL, retrieve the returned data set or the results of the command, and disconnect from the data source. ODBC standardizes the error messages, the data source log-on interface, data types, and even the SQL grammar that's available, so you can use the same commands, interpret the same error messages, and use the same log-on and SQL dialect for every different supported DBMS.

While you can call API functions to perform any ODBC database operation, you can also use SQL. ODBC supports its own SQL dialect as well as any SQL dialect supported by the target DBMS and will translate from its own dialect to the target's SQL as needed.

ODBC provides a set of extended functions and an extended SQL grammar that lets you use advanced data types

(such as date, time, time stamp, and binary objects), create scrollable cursors (for record-at-a-time processing), perform asynchronous queries, and fetch or update entire arrays of data. The SQL grammar can be used to execute outer joins and stored procedures, and the function set lets you query a data source for extended functionality of its own. In addition, the extended functions and SQL grammar provide full transaction support with rollback and commit facilities.

In short, ODBC provides the kinds of facilities you'd expect in mission-critical, on-line transaction processing systems and decision support systems. And using ODBC makes sense from the end user's perspective, too: ODBC can provide a list of data sources that you can select from, and you or your applications can use SQL to access these sources. With an ODBC-compliant application, you can access any number of different data sources if the database drivers are available.

HOW IT WORKS The key to ODBC's transparent data access is a set of drivers and a component called the ODBC data manager. When your application calls the ODBC API, it's really calling the data manager, which implements the ODBC API. The data manager translates ODBC API calls into calls to a driver for the particular database file format that your application is accessing (Figure 1). Under Windows, the drivers and the data manager are implemented as DLLs (for example, the data manager under Windows is ODBC.DLL).

The ODBC data manager is at the heart of this scheme. It's the data manager that sits between your application and the drivers to provide connectivity between an application and a network and manages exchanges between the application and specific DBMSs. Since the data manager processes API calls, it can perform argument-checking and dynamically load and unload ODBC drivers as they're needed. The data manager also provides various services to applications, such as creating a list of available data sources. Finally, it can translate standard SQL queries into a native SQL dialect if that's required by the data source.

Each ODBC-compliant application can use the data manager to communicate with more than one driver at a time, and thus each application can use the same API to access a number of file formats or even make multiple connections to the same data source at the same time. Of course, access to each file format assumes that the appropriate driver is available and has been installed. In any event, the user doesn't need a new version of an ODBC-compliant application to access each new DBMS.

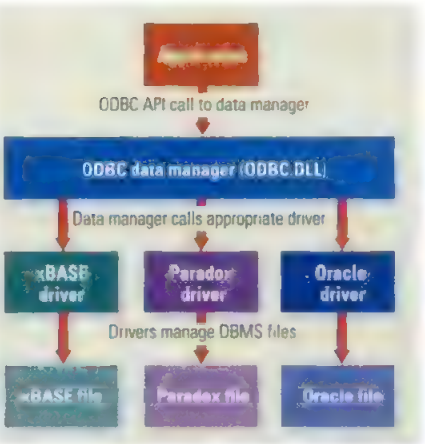

Figure 1: **This diagram illustrates the relationship among Microsoft ODBC, an application, and the application's drivers. An ODBC-compliant application uses the ODBC API to call the ODBC data manager, which performs a database operation. The data manager in turn will translate the API call into a call to the appropriate DBMS driver, which performs the operation on the appropriate DBMS file.**

BRINGING ODBC TO YOUR APPLICATIONS There are essentially two ways of building ODBC support into your applications: using the ODBC Software Development Kit (SDK) to call the ODBC API directly or using an ODBC-compliant DBMS, tool, or add-on.

The ODBC SDK, Version 1.0, was originally released in September 1992. It included a comprehensive description of ODBC, including a programmer's reference, sample source code, the driver manager (in the form of a Windows DLL), and an ODBC administrator (for creating, configuring, adding, and deleting databases and tables). It also included a program to test new DBMS drivers, a Visual Basic application that uses ODBC, and a driver for accessing Xbase files.

In the fall of 1993, Microsoft released the beta version of the ODBC SDK, Version 2.0, with the final version due to be released in the first quarter of 1994. Version 2.0 version includes the Version 1.0 SDK plus full support for 32-bit Windows architectures (primarily Windows NT and the forthcoming 32-bit desktop version of Windows, code-named Chicago). The 2.0 SDK also includes a new SETUP.DLL for installing database drivers, an expanded library of working sample applications, support for scrollable cursors from all data sources, database navigation extensions, and more extensible test tools. There's also a template ODBC driver, written in C, that you can use to create your own drivers. (To order the ODBC SDK, send an e-mail note to the Internet address odbcbeta@microsoft.com.)

If you're writing your applications in Pascal, C, or assembler, the SDK is probably your best choice. Otherwise, there are a number of easier-to-use alternatives. One is to use an ODBC-compliant DBMS like Microsoft Access or PowerSoft's PowerBuilder. (A future version of Microsoft FoxPro is expected to be fully ODBC-compliant, as are other popular DBMSs.)

Developers who use Visual Basic and C++ have another choice. Visual Basic has had built-in ODBC-compliant data controls since Version 2.0, and C++ developers who use Borland C++ 4.0 or Microsoft Visual C++ 1.*x* can use third-party controls. For instance, Coromandel's Integra VDB (Visual Database Builder) provides a set of ODBC controls

Figure 2: **This screenshot shows the results of using Coromandel's drag-and-drop database controls in Visual C++. Using ODBC-compliant database controls in environments such as Visual C++, Borland C++, or Visual Basic, you can easily add ODBC database capabilities to a form or dialog.**

that are as powerful as those found in VB. Both sets of controls, Coromandel's and Visual Basic's, provide support for ODBC databases, tables, and dynamic data sets.

Whether you develop applications with Visual Basic or C++, the way to add ODBC data compliance is essentially the same. Data-aware controls replace conventional Windows edit, list-box, combo-box, and button controls. With a few commands, the visual environment will scan the tables in an ODBC data source and drop an edit control for every column in every table into a dialog or form (see Figure 2).

If you're not currently using an ODBC-compliant DBMS or data access method, you're likely to be using one in the future.

The development environment will set specific properties in each control to tie it to the appropriate database column. Then you can add push buttons to execute database commands like add, update, and delete, and give the user the ability to perform the operations on a displayed database record. There's even a special VCR-like toolbar, which lets users navigate a database table. With relatively little time and effort invested, you can produce a database application like the one shown in Figure 3 (which took less than a half hour to produce).

Finally, Visual C++ 1.5 provides yet another approach: a set of C++ classes that encapsulate ODBC operations to let you create applications just as quickly but that use object-oriented programming techniques.

CONCLUSION If you're not currently using an ODBC-compliant DBMS or data access method, you're likely to be using one in the future. You can currently access DB2, Oracle, SQL Server, DEC Rdb, Xbase, and Paradox files from ODBC, and Microsoft has indicated that ODBC drivers are in the works for connecting to IBM's Distributed Relational Database Architecture (DRDA), a protocol for connecting DBMSs over its SNA (IBM's Systems Network Architecture) networks. Even Apple has endorsed ODBC, announced an ODBC SDK for the Macintosh, and indicated that System 7 will support ODBC in the future. There are currently two dozen commercially available ODBC-compliant applications, and two dozen drivers are available.

While Borland, IBM, Novell and WordPerfect have declared their own standard for database connectivity, the Integrated Database Application Programming Interface (IDAPI). This standard is designed to be implemented by DBMS vendors—not by application developers—and has yet to appear in any commercial product. In the meantime, Borland officials say that IDAPI will complement ODBC and that any ODBC-compliant driver will be accessible via IDAPI without modification.

While some may have trepidation over yet another Microsoft standard, the fact is, a great deal of what ODBC is about simply makes sense as distributed database systems pervade corporate computing. □

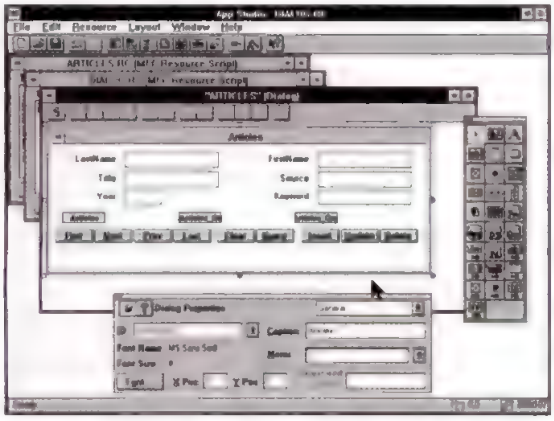

Figure 3: **This is a shot of an application written using the Integra controls. Creating an application like this one is a snap and took less than a half hour using Coromandel's ODBC-compliant database controls and Visual C++.**

RICHARD HALE SHAW IS A CONTRIBUTING EDITOR OF *PC MAGAZINE*.

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Toolkits

BY SAL RICCIARDI

Reformat and Analyze C Code With C-Vision

C-Vision ($139), from Gimpel Software, is a collection of tools that help you format, analyze, understand, and maintain C source code. It's particularly well suited to those instances when you have to maintain or modify code written by someone else, but it's also handy for applying a standard coat of wax to your own code. The package, which replaces an earlier product called C:Lines/C:Tree, goes way beyond pretty printing, with features that let you cross-reference and analyze source code.

ORGANIZING CHAOS The C-Vision source-code formatter, called C-Format, turns gobbledygook into readable C code using any of several different coding styles and numerous options. For example, you can tell C-Format to break lines where necessary in order to align braces vertically. Each brace ends up on a line by itself. Or if you prefer, you can place the opening brace together with the previous line of code. If you have code that crams multiple C statements onto the same line, the formatter can split them into as many lines as needed while maintaining proper indentation. Comments can be converted between C++ style and C style.

C-Vision's comment formatter (called C-Comment) can rearrange comments in many different ways. For example, you can align comments left or right to a certain column position or shift the comments just enough to avoid overlapping the code.

The C-Vision source-code lister (called C-Lines) takes your C input files and outputs them with some optional readability enhancements; line numbers and visual cues of program structure are added to the left of the code. Statements enclosed within braces are marked with vertical lines, and the positions of all break and continue statements are clearly shown. In fact, blocks that respond to the break and continue statements (`while`, `do`, `for`, and `switch`) have a distinctive outline to make them stand out. Return statements are marked on the outline of the enclosing functions so that all exits from a function can be readily identified. This type of outlining helps clarify the structure of the code and is useful for spotting errors. For example, nested blocks are easily identified and the positions of any unbalanced braces become obvious.

The lister correctly handles in-line assembly language code and can print C keywords or comments in user-defined formats, such as bold, italics, underscore, or a different font depending on printer support. (Supplying printer control codes is up to you.)

DETAILED CROSS-REFERENCING The C-Vision cross-referencer (called C-Xref) produces detailed multifile cross-reference listings of each symbol along with the filenames and the line numbers where it's referenced. Each reference includes a special usage marker that further explains how the symbol is used. For example, a definition or declaration reference might appear as `#10`, meaning the symbol was either defined or declared on line 10.

By default, the cross-referencer identifies local symbols by appending the word LOCAL to the description in the listing. Local symbols, macros, symbols from library headers, and references to library headers can be individually included or suppressed. Structure members are correctly identified. For example, an integer within a struct might appear in the cross-reference as `myvar, int in struct MyStruct`.

A new addition called C-Tdump lets you output all of the information generated by the cross-reference parser into a set of comma-delimited files that can easily be imported into a database management system or directly manipulated by custom code.

The C-Vision tree diagrammer, called C-Tree, produces a number of useful analyses. For example, it can produce several hierarchical tree reports, which highlight function-call usage. Or it can produce a dictionary of functions showing each function's name, arguments, return type, and location.

C-Vision has numerous configuration options. A configuration file tells C-Vision about your compiler environment and your printer or printers, and it controls many aspects of how C-Vision functions. Many of these options can also be specified on the command line. A number of sample configuration files are supplied for different compilers and printers.

Version 3.10 includes 386-specific versions of the programs compiled with Phar Lap's 386-DOS Extender, giving you full access to all of the memory in your machine and letting you analyze and cross-reference very large programs.

If you are particular about the appearance of your code—and especially if you work with C code inherited from someone else—you'll find C-Vision to be an invaluable addition to your programming tool chest.

• C-Vision, Version 3.10

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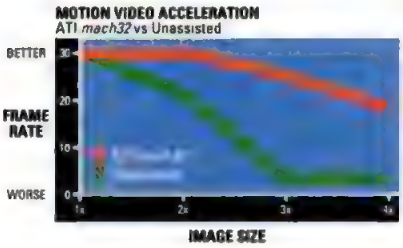

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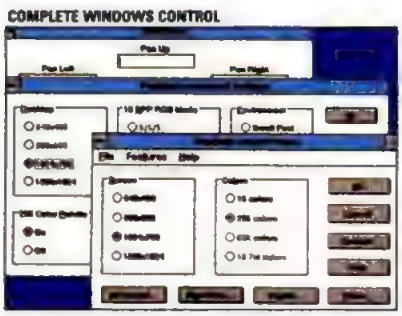

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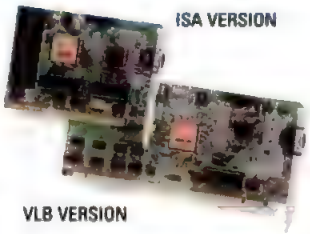

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Environments

BY CHARLES PETZOLD

Graphics Paths Under Windows NT

In the past few columns, I've been exploring enhancements to the line-drawing capabilities of the Graphics Device Interface (GDI) as implemented under Windows NT. In particular, the ExtCreatePen() function lets you draw wide lines, the interiors of which can be filled with solid colors, hatch patterns, or bitmaps. You can also choose various styles (combinations of dots and dashes) for these lines or even define your own styles. Moreover, wide lines can have different ends (round, square, or flat) and joins (round, bevel, or miter); the line join affects the appearance of lines that are connected to each other.

Wide pens under Windows NT are known as *geometric* pens. The width of the pen you specify in the ExtCreatePen() function is in logical units and hence is subject to any transforms that may be in effect. In contrast, cosmetic pens always have a width of 1 pixel.

The Graphics Programming Interface (GPI) of the OS/2 Presentation Manager also differentiates between lines drawn with a geometric width and a cosmetic width. But OS/2 defines two cosmetic widths—a normal width (generally 1 pixel on video displays) and a thick width (which is double the normal width).

OS/2 is different from Windows NT in another way: Under the OS/2 GPI you can only draw a geometrically wide line using a path. (I discussed the GPI implementation of paths in the Environments column of May 25, 1993 and showed in subsequent issues how they can be used with outline fonts.) As we've seen, Windows NT has no such restriction. You can draw geometric lines without even knowing what a path is. Paths are supported under Windows NT, however, and they have several important uses. That's what we'll begin to explore in this column.

POSING THE PROBLEM To understand one way in which paths are useful, let's pose some simple graphics problems and see how to solve them. Here's the first. Using a 1-inch wide line, draw a figure composed of five connected lines:

- a 2-inch horizontal line going right,
- a 3-inch vertical line going up,
- a 3-inch horizontal line going right,
- a 3-inch vertical line going down, and
- a 2-inch horizontal line going right.

The lines should have flat ends where the figure begins and ends, but round joins where the lines connect. (This is the part that will give us the most trouble.)

Under Windows NT you can draw geometric lines without even knowing what a path is. Paths are supported, however, and they have several important uses.

The first attempt to draw this figure is shown in the PROB1 code in Figure 1. This program—as well as the others in this column—require the NTGDI files shown in the January 11, 1994 Environments column. You can download all of the files from PC MagNet's Programming Forum archived as NTPATH.ZIP.

PROB1 begins by setting the mapping mode to MM_LOENGLISH. Thus, logical units passed to GDI function calls will be in units of 0.01 inches. The SetViewportOrgEx() function—the Windows NT replacement for SetViewportOrg()—moves the coordinate origin to the lower-left corner. Next, PROB1 sets up a LOGBRUSH structure and creates and selects a geometrically wide solid pen. The pen has a width of 100 units (1 inch) with flat ends and round joins. Then a MoveToEx() call followed by five LineTo() calls draw the figure. The MoveToEx() function—the Windows NT equivalent of MoveTo()—sets an initial current position. Each of the LineTo() functions draws a line from the current position to the point specified in the function, and then sets the current position to that point. The results are shown in screenshot A in the sidebar "Windows NT Graphics Paths."

As you can see, this approach simply does not work. Each of the five lines that constitute the figure has flat line ends but not the round line joins we requested. What happened? Well it should be obvious: When the program calls LineTo() to draw each of the lines, GDI doesn't know that the call will soon be followed by another LineTo() call to continue the figure. Thus, GDI has no choice but to give each of the five lines two flat ends.

CONNECTING THE LINES One solution to this problem isn't very difficult and doesn't require paths. You simply set up an array containing the six points that define the figure and replace the MoveToEx() and LineTo() functions with a call to Polyline(). The code for the PROB2 program is shown in Figure 2 Because this version of the program uses Polyline() to draw all the lines, GDI knows that the lines are supposed to be connected. GDI can draw flat ends at the beginning and end of the figure but round joins where the lines connect. This solution is shown in screenshot B in the sidebar. Success!

NOW TRY THIS ONE Now that we've solved that problem, let's quickly tackle another before we get overconfident. Here we go: Draw a figure similar to the one described above, but one in which the three straight lines in the middle (the arch-like part of the figure) are replaced

PROB1.C
Complete Listing

```
/*--------------------------------------
   PROB1.C - Line-Drawing Problem #1
             (c) Charles Petzold, 1994
  --------------------------------------*/

#include <windows.h>

char szClass [] = "Prob1" ;
char szTitle [] = "Prob1: Line-Drawing Problem #1" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     LOGBRUSH lb ;

     SetMapMode (hdc, MM_LOENGLISH) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     lb.lbStyle = BS_SOLID ;
     lb.lbColor = RGB (0, 0, 0) ;
     lb.lbHatch = 0 ;

     SelectObject (hdc,
         ExtCreatePen (PS_GEOMETRIC | PS_SOLID |
                       PS_ENDCAP_FLAT | PS_JOIN_ROUND,
                       100, &lb, 0, NULL)) ;

     MoveToEx (hdc, 100, 100, NULL) ;
     LineTo   (hdc, 300, 100) ;
     LineTo   (hdc, 300, 400) ;
     LineTo   (hdc, 600, 400) ;
     LineTo   (hdc, 600, 100) ;
     LineTo   (hdc, 800, 100) ;

     DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
     }
```

***Figure 1:* PROB1.C shows the wrong way to draw connected straight lines with ends and joins.**

by an arc that is one-half of the circumference of an ellipse. Oops! Polyline() won't help us here. Let's at least try to draw something that resembles our goal, as shown in the PROB3 listing in Figure 3.

The program draws the figure by using MoveToEx() and LineTo() for the first horizontal line, then the Arc() function, followed by another set of MoveToEx() and LineTo() calls for the last horizontal lines. Note the use of the SetArcDirection() function—new with Windows NT—to draw the arc in a clockwise direction rather than the default counterclockwise direction. In the Arc() function, the first two pairs of coordinate points indicate the bounding rectangle that defines the size of the total ellipse. The second two pairs of coordinate points indicate the beginning and end of the arc.

Of course, it doesn't work right. The three components of the figure each have flat line ends but no rounded line joins, as screenshot C shows. The solution requires two changes to the code. First, the Arc() function must be replaced with ArcTo(), a function new with Windows NT but with the same parameters as Arc(). Unlike the Arc() function, the ArcTo() function uses and sets the current position. If the current position is not the same point where the arc begins, then ArcTo() draws a straight line from the current position to the beginning of the arc. Then the arc is drawn and the current position is set to the end of the arc.

The PROB4 code in Figure 4 shows the use of ArcTo(). Everything else is essentially the same as PROB3 except that the second MoveToEx() call is not required because the current position is already set by the ArcTo() function. (Removing the second MoveToEx() call will turn out to be important, by the way.)

This change is not sufficient, however. The PROB4 display is identical to the PROB3 display. GDI does not know that the first LineTo() call and the ArcTo() call will be followed by another drawing function that continues the figure. Thus, the straight lines and the arc get flat line ends but not round line joins.

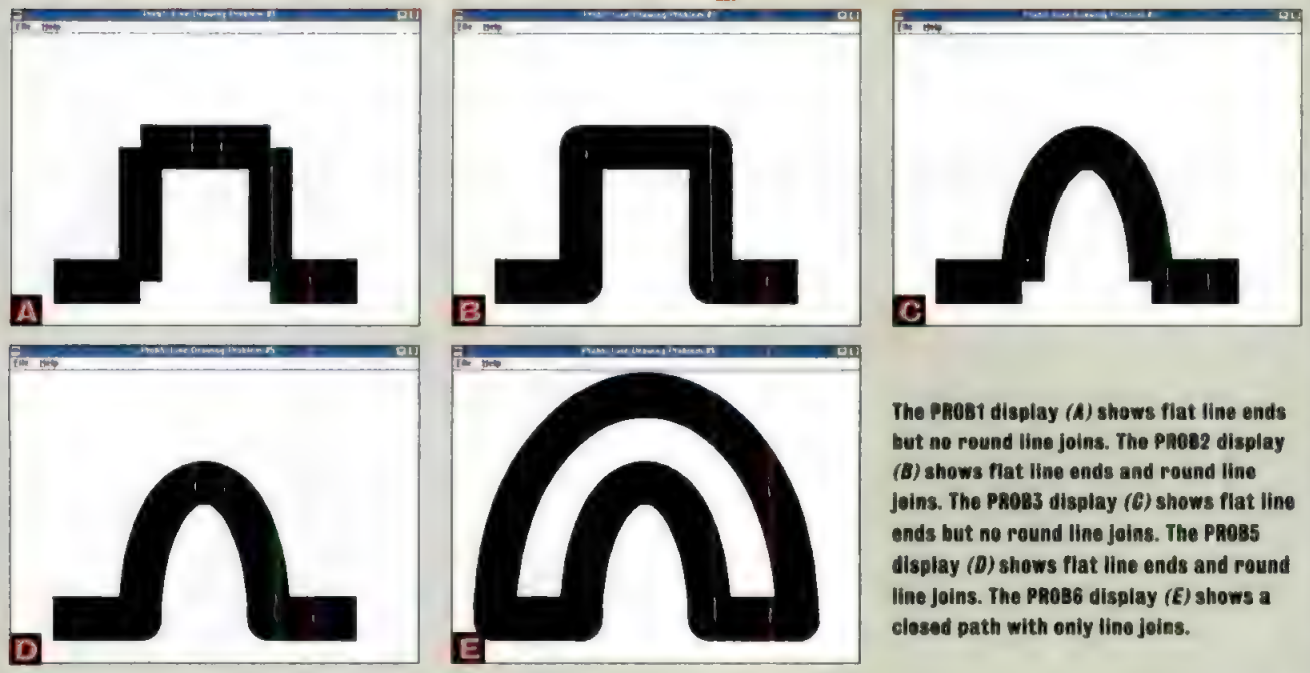
PATHS TO THE RESCUE It's time to step back and think about what we need to do. For GDI to draw two connected wide lines with a join, it needs to know about the second line before it draws the first. We accomplish this in the PROB2 program using Polyline(). But there's no single function that will draw both straight lines and arcs. If we could somehow accumulate a collection of connected straight-line and curve definitions in memory, and then tell GDI to draw the completed figure in one shot, that might work. And that's what we can do with a path. Let's look at the revised program first and then examine paths more methodically. The PROB5 program is shown in Figure 5.

PROB2.C
Complete Listing

```
/*--------------------------------------
   PROB2.C - Line-Drawing Problem #2
             (c) Charles Petzold, 1994
  --------------------------------------*/

#include <windows.h>

char szClass [] = "Prob2" ;
char szTitle [] = "Prob2: Line-Drawing Problem #2" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     static POINT pt [] = { 100, 100,  300, 100,  300, 400,
                            600, 400,  600, 100,  800, 100 } ;
     LOGBRUSH     lb ;

     SetMapMode (hdc, MM_LOENGLISH) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     lb.lbStyle = BS_SOLID ;
     lb.lbColor = RGB (0, 0, 0) ;
     lb.lbHatch = 0 ;

     SelectObject (hdc,
         ExtCreatePen (PS_GEOMETRIC | PS_SOLID |
                       PS_ENDCAP_FLAT | PS_JOIN_ROUND,
                       100, &lb, 0, NULL)) ;

     Polyline (hdc, pt, 6) ;

     DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
     }
```

***Figure 2:* PROB2.C shows one correct way to draw connected straight lines with ends and joins.**

Windows NT Graphics Paths



The PROB1 display *(A)* shows flat line ends but no round line joins. The PROB2 display *(B)* shows flat line ends and round line joins. The PROB3 display *(C)* shows flat line ends but no round line joins. The PROB5 display *(D)* shows flat line ends and round line joins. The PROB6 display *(E)* shows a closed path with only line joins.

A call to BeginPath() precedes the line-drawing functions, marking the beginning of a path bracket. Following this call, any line-drawing functions will not be rendered on the display but will instead be accumulated as part of the path definition. The path definition ends with a call to EndPath(). The PROB5 program renders the completed path on the display by calling StrokePath(). The results are shown in screenshot D in the sidebar. Finally we have it right!

As an exercise, you can add these three function calls to PROB1. The results will look the same as the PROB2 display.

PATHS AND SUBPATHS A path is a collection of straight-line and curve definitions stored internally in GDI memory. You begin a path bracket by calling BeginPath() and end it by calling EndPath(). Then you can do something with the path by calling any of several functions, one of which is StrokePath(). (We'll examine others in future installments of this column.) A path composes one or more subpaths. (The path created in PROB5 has only one subpath.) A subpath is a series of *connected* straight lines and curves. If you want to use line ends and joins properly, you need to know how to connect straight lines and curves to make a subpath.

The connection of lines to form a subpath is based entirely upon the current position. Prior to Windows NT, the current position wasn't used much in GDI. Basically, you had one function that set the current position (MoveTo()), another function that used it and set it (LineTo()), and a third that returned it (GetCurrentPosition()). In addition, by using the TA_UPDATECP parameter in SetTextAlign(), the TextOut() and ExtTextOut() functions also use and set the current position.

With Windows NT, the current position has become very important in creating paths. For example, consider the following series of function calls in a path bracket:

```
MoveToEx (hdc, 100, 100, NULL) ;
LineTo (hdc, 200, 200) ;
MoveToEx (hdc, 200, 200, NULL) ;
LineTo (hdc, 300, 100) ;
```

and compare it with

```
MoveToEx (hdc, 100, 100, NULL) ;
LineTo (hdc, 200, 200) ;
LineTo (hdc, 300, 100) ;
```

Back in the old DOS-based Windows days, these two chunks of code would perform identically. But in a path definition, they are quite different. In the first case, two subpaths are created, each of which consists of a single straight line. In the second case, there is only one subpath, consisting of two connected straight lines. When you stroke the path, you'll get a line join in the second case but not in the first. That's why it was important to remove the second MoveToEx() call in the transition from PROB3 to PROB5. (Try putting it back and note the difference—there won't be a round line join connecting the arc with the final line.)

Because the current position has been elevated to such importance, several new GDI function calls have been added to Windows NT. To connect straight lines and curves in a subpath, you must use line-drawing functions that use and set the current position. These functions are: AngleArc(), ArcTo(), LineTo(), PolyBezierTo(), PolylineTo(), and PolyDraw().

With the exception of LineTo(), all these functions are new. As we've seen, the ArcTo() parameters are identical to

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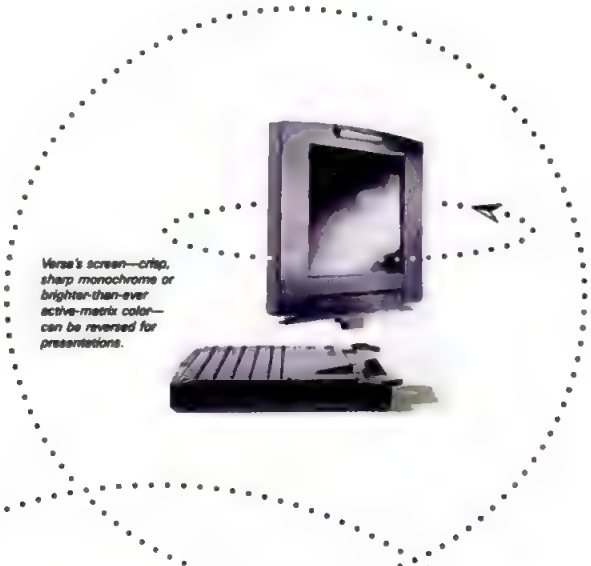

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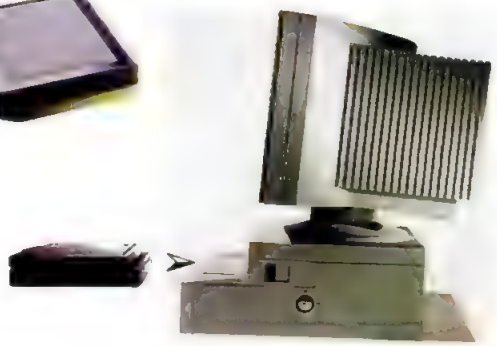

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NEC

PROB3.C
Complete Listing

```
/*----------------------------------------
   PROB3.C - Line-Drawing Problem #3
             (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>

char szClass [] = "Prob3" ;
char szTitle [] = "Prob3: Line-Drawing Problem #3" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     LOGBRUSH lb ;

     SetMapMode (hdc, MM_LOENGLISH) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     lb.lbStyle = BS_SOLID ;
     lb.lbColor = RGB (0, 0, 0) ;
     lb.lbHatch = 0 ;

     SelectObject (hdc,
          ExtCreatePen (PS_GEOMETRIC | PS_SOLID |
                        PS_ENDCAP_FLAT | PS_JOIN_ROUND,
                        100, &lb, 0, NULL)) ;

     SetArcDirection (hdc, AD_CLOCKWISE) ;

     MoveToEx (hdc, 100, 100, NULL) ;
     LineTo   (hdc, 300, 100) ;

     Arc      (hdc, 300, 400, 600, -200, 300, 100, 600, 100) ;

     MoveToEx (hdc, 600, 100, NULL) ;
     LineTo   (hdc, 800, 100) ;

     DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
     }
```

Figure 3: **The PROB3.C listing illustrates the wrong way to draw connected lines and arcs with ends and joins.**

PROB4.C
Complete Listing

```
/*------------------
   PROB4.C - Line-Drawing Problem #4
             (c) Charles Petzold, 1994
  ------------------*/

#include <windows.h>

char szClass [] = "Prob4" ;
char szTitle [] = "Prob4: Line-Drawing Problem #4" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     LOGBRUSH lb ;

     SetMapMode (hdc, MM_LOENGLISH) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     lb.lbStyle = BS_SOLID ;
     lb.lbColor = RGB (0, 0, 0) ;
     lb.lbHatch = 0 ;

     SelectObject (hdc,
          ExtCreatePen (PS_GEOMETRIC | PS_SOLID |
                        PS_ENDCAP_FLAT | PS_JOIN_ROUND,
                        100, &lb, 0, NULL)) ;

     SetArcDirection (hdc, AD_CLOCKWISE) ;

     MoveToEx (hdc, 100, 100, NULL) ;
     LineTo   (hdc, 300, 100) ;

     ArcTo    (hdc, 300, 400, 600, -200, 300, 100, 600, 100) ;

     LineTo   (hdc, 800, 100) ;

     DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
     }
```

Figure 4: **PROB4.C illustrates another wrong way to draw connected lines and arcs with ends and joins. Its display is identical to the PROB3.C display.**

Arc(). But ArcTo() possibly draws a straight line from the current position to the beginning of the arc, then draws the arc, and sets the current position to the end of the arc. PolylineTo() has the same syntax as Polyline(), but the first line is drawn from the current position to the first point in the PolylineTo() array. After the function has completed, the current position is set to the end of the last line. With the same parameters, PolylineTo() draws one more line than Polyline(). For example, with an array of five points, PolylineTo() draws five lines but Polyline() draws only four.

AngleArc() is a new function that draws an arc based on a center coordinate, a radius, and two sweep angles. In some cases, this may be more convenient than using the Arc() or ArcTo() functions. PolyBezierTo() is a form of the PolyBezier() function that uses and sets the current position.

The PolyDraw() function is interesting: With one call, this function can perform a series of operations equivalent to MoveToEx(), PolylineTo(), PolyBezierTo(), and CloseFigure() (which I'll discuss shortly).

The MoveToEx() call ends the previous subpath and begins a new subpath without adding anything to the path. The PolyDraw() function can also cause a change in current position. In addition, it's possible to change implicitly the current position without calling MoveToEx() or PolyDraw(). In short, any function call within the path bracket that causes the current position to change from the previous *physical* location on the display also begins a new subpath. This happens if you change the mapping mode, viewport or window extents, viewport or window origins, or the world transform.

The following line-drawing function calls also begin a new subpath because they do not use the current position: Arc(), Chord(), Ellipse(), ExtTextOut(), Pie(), PolyBezier(), Polygon(), Polyline(), PolyPolygon(), PolyPolyline(), Rectangle(), RoundRect(), and TextOut(). With the exception of PolyBezier, these functions are all supported under the DOS-based version of Windows. Any subsequent line-drawing function call begins a new subpath, even if that function uses

PROB5.C
Complete Listing

```
/*----------------------------------------
   PROB5.C - Line-Drawing Problem #5
             (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>

char szClass [] = "Prob5" ;
char szTitle [] = "Prob5: Line-Drawing Problem #5" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     LOGBRUSH lb ;

     SetMapMode (hdc, MM_LOENGLISH) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     lb.lbStyle = BS_SOLID ;
     lb.lbColor = RGB (0, 0, 0) ;
     lb.lbHatch = 0 ;

     SelectObject (hdc,
          ExtCreatePen (PS_GEOMETRIC | PS_SOLID |
                        PS_ENDCAP_FLAT | PS_JOIN_ROUND,
                        100, &lb, 0, NULL)) ;

     SetArcDirection (hdc, AD_CLOCKWISE) ;

     BeginPath (hdc) ;

     MoveToEx (hdc, 100, 100, NULL) ;
     LineTo   (hdc, 300, 100) ;

     ArcTo    (hdc, 300, 400, 600, -200, 300, 100, 600, 100) ;

     LineTo   (hdc, 800, 100) ;

     EndPath (hdc) ;
     StrokePath (hdc) ;

     DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
     }
```

Figure 5: **The PROB5.C listing illustrates the correct way to draw connected lines and arcs with ends and joins, which is by creating a path.**

the current position. A previous subpath cannot be continued later if a new subpath intervenes.

OPEN AND CLOSED PATHS Consider the following function calls within a path bracket:

```
MoveToEx (hdc, 100, 100, NULL) ;
LineTo (hdc, 500, 100) ;
LineTo (hdc, 300, 400) ;
LineTo (hdc, 100, 100) ;
```

These calls draw a triangle. However, although the vertices at the points (500, 100) and (300, 400) will be drawn with line joins, the two lines that meet up at (100, 100) will be drawn with line ends. GDI considers this subpath to be *open*, that is, the end point does not connect to the beginning point (even though they're the same point).

To make a closed path, you must call the CloseFigure() function or do a closefigure operation in the PolyDraw() function. The CloseFigure() function may only be called within a path bracket. It ends a subpath by connecting (with a straight line, if necessary) the current position and the beginning point of the subpath. A closed subpath will be rendered only with line joins and not with line ends. In addition, the Chord(), Ellipse(), Pie(), Polygon(), PolyPolygon(), Rectangle(), and RoundRect() functions also create closed subpaths.

Let's convert the open path in PROB5 to a closed path in PROB6 by adding another ArcTo() call and a CloseFigure() call, as shown in Figure 6. The results are shown in screenshot E.

As an exercise, you may want to remove the CloseFigure() call to see the difference: GDI will draw the beginning and end of the figure with line ends rather than joins. Another interesting exercise is to leave in the CloseFigure() call but remove the second ArcTo() call.

As you might expect, we've only just scratched the surface of paths, and I'll continue with them in the next installment of this column. □

PROB6.C
Complete Listing

```
/*----------------------------------------
   PROB6.C - Line-Drawing Problem #6
             (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>

char szClass [] = "Prob6" ;
char szTitle [] = "Prob6: Line-Drawing Problem #6" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     LOGBRUSH lb ;

     SetMapMode (hdc, MM_LOENGLISH) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     lb.lbStyle = BS_SOLID ;
     lb.lbColor = RGB (0, 0, 0) ;
     lb.lbHatch = 0 ;

     SelectObject (hdc,
          ExtCreatePen (PS_GEOMETRIC | PS_SOLID |
                        PS_ENDCAP_FLAT | PS_JOIN_ROUND,
                        100, &lb, 0, NULL)) ;

     SetArcDirection (hdc, AD_CLOCKWISE) ;

     BeginPath (hdc) ;

     MoveToEx (hdc, 100, 100, NULL) ;
     LineTo   (hdc, 300, 100) ;

     ArcTo    (hdc, 300, 400, 600, -200, 300, 100, 600, 100) ;

     LineTo   (hdc, 800, 100) ;

     SetArcDirection (hdc, AD_COUNTERCLOCKWISE) ;

     ArcTo    (hdc, 100, 600, 800, -400, 800, 100, 100, 100) ;

     CloseFigure (hdc) ;

     EndPath (hdc) ;
     StrokePath (hdc) ;

     DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
     }
```

Figure 6: **PROB6.C makes a closed path with only line joins.**

Power Programming

BY DANNY THORPE

Cross-Platform DLLs for DOS and Windows

Most Windows programmers take DLLs (dynamic link libraries) for granted, but DOS programmers have long desired the flexibility and the language-independent code-sharing capability of DLLs for their programs, without the complexities and overhead of Windows.

Borland's DOS-extender technology fills that shortcoming by allowing protected-mode DOS programs to use DLLs the same way Windows programs do. What's more, the Borland DOS extender allows DOS programs to use DLLs that are compiled for the Windows environment. If a DLL performs only data-processing services and contains no direct user-interface code, the same DLL executable module can be used by a Windows program and a protected-mode DOS program, without recompiling any source code.

This Borland DOS-extender technology is an integral part of Borland Pascal 7.0 (BP7). With BP7, Pascal programmers can produce protected-mode DOS applications that use DLLs compiled for Windows, with little regard to which programming language created those DLLs.

Even if you're not a DOS or Pascal programmer, if you produce nonvisual data-processing DLL engines for your Windows-programming customers, you could expand your market to include DOS programmers by using techniques described here.

In this column, we'll review the Borland DOS extender's support for DOS/Windows DLLs and explore specific techniques to help ensure your Pascal or C DLLs work in both the DOS and Windows environments. To get the most from this article, you should have a general understanding of protected-mode programming (DOS or Windows), DPMI (DOS Protected-Mode Interface), and the features and uses of Windows DLLs.

OPERATING SYSTEM LAYERS DOS is incompatible with the protected mode of the 80286 or later CPUs, since DOS was designed solely for the IBM PC's 8086, 16-bit system architecture. By a maze of clever tricks, however, it's possible to create a DOS program that runs in protected mode but switches the CPU into 8086 real mode whenever a DOS service is needed (reading from a file, for example). The mechanism that manages these mode-switching tricks is known as a *DOS extender*. Windows is by far the most widely used DOS extender, since it is a protected-mode operating environment that sits on top of real-mode DOS. The DOS Protected-Mode Interface specification defines a minimum set of system services that a DOS extender should provide for protected-mode DOS programs. Windows and OS/2 DOS boxes provide DPMI services, as does the Borland DOS extender.

Borland's DOS-extender technology allows DOS programs to use DLLs the same way that Windows programs can—even to use the same DLLs.

You could think of the Windows internals as being divided into layers, with DOS at the bottom, the Windows internal DPMI server on top of DOS, the Windows memory and module manager on top of DPMI, the Windows device and system interface on top of that, and your programs at the very top (Figure 1, right).

BORLAND DOS EXTENDER The Borland DOS extender is implemented in two layers. Like Windows, the Borland DOS extender includes a DPMI server that sits on top of DOS and a memory- and module-management layer that sits on top of the DPMI server. Your protected-mode DOS programs run on top of these service providers (Figure 1, left).

BP7 protected-mode DOS programs are compatible with other vendors' DPMI servers. You can run BP7 protected-mode DOS programs in a Windows DOS box, in an OS/2 DOS box, or in DOS with either a Qualitas 386MAX or with a Quarterdeck QEMM-386 DPMI device driver loaded. When starting your program, if the EXE stub loader inside your program finds that DPMI services are already available, the program will use the existing DPMI server instead of loading the Borland DPMI server. The Borland DPMI server is only loaded if DPMI services are not already available to your program.

The Borland memory and module manager will always be loaded with your BP7 protected-mode DOS application, regardless of what DPMI environment you're running in. RTM (runtime manager) provides a number of high-level services beyond the scope of the DPMI specification, such as movable memory, discardable memory, code-segment swapping, resource-allocation tracking and cleanup, program-crash recovery and cleanup, virtual memory on-disk, and DLL support.

Your program code almost never di-

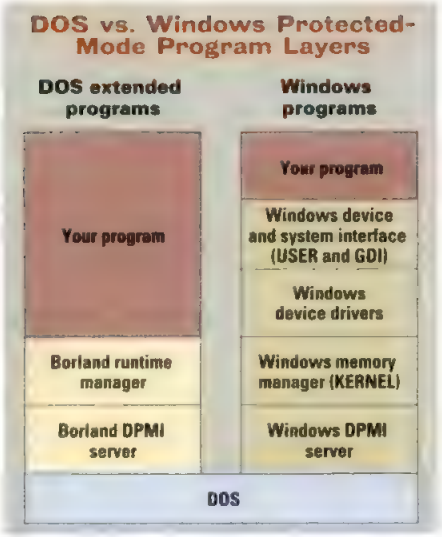

Figure 1: **Like the Windows memory model (on the right), Borland's DOS-extender technology (left) is implemented in multiple layers. In both memory models, protected-mode programs run above code that provides operating-system services.**

rectly calls RTM functions, but your program benefits from RTM's services and behind-the-scenes DOS-environment fortifications and safety nets. RTM makes the raw DPMI environment a much more comfortable place for your programs to live and for you to work.

WINDOWS API IN DOS PROTECTED MODE

RTM provides a subset of the Windows API (application programming interface) to protected-mode DOS programs and to DLLs. RTM emulates most of the Windows memory management, module management, and resource-loading functions found in Windows' KERNEL module. This Windows API compatibility is the critical element that enables DOS/Windows cross-platform DLLs.

You'll find a list of the emulated functions in the WINAPI.PAS and WINAPI.H files, which you can download from the Programming Forum of PC MagNet (along with the source code and compiled executable files described in this article; look for the file WINAPI.ZIP). If your Windows DLLs (your source code and your compiler's runtime libraries) use only the RTM-supported Windows functions, then your DLLs can be used by Windows applications and protected-mode DOS applications without recompiling anything. RTM works independently of Windows (you don't need any part of Windows to run a Windows DLL under RTM).

RTM, on the other hand, does not emulate user-interface, graphics, messaging, or multitasking functions found in Windows' USER, GDI, and other modules. What DOS programs need most from a DOS extender are memory and module management and interrupt assistance; if you need the other features of Windows, you should probably be writing Windows programs.

When RTM loads your protected-mode program into memory, it goes through the same implicit DLL loading and function-address fixes that the Windows program loader performs:

1. If RTM can't find the DLL module of the requested function, RTM will refuse to load your application (same as in Windows).

2. If RTM can find the DLL but cannot find the requested function in that DLL, RTM will return the address of an internal error routine but will not indicate an error. If your program calls this function address, the program will terminate with an error message (same as in Windows 3.1). This is sometimes called *quiet* mapping to fatal exit routines. Your code (program or DLL) can use convenient, static DLL function references to Windows' KERNEL functions that RTM doesn't support, yet RTM will still load your code. As long as your code avoids calling the unsupported functions when running in DOS protected mode, your code will load and run without any problems.

3. If RTM finds the requested function and DLL, RTM will return the address of the function (just like Windows).

Explicit DLL loading and dynamic binding work exactly the same in RTM as in Windows. You call LoadLibrary to load a DLL and call GetProcAddress for a function address in that DLL, just as you would in Windows.

If the DLL can't be found or the function can't be found in that DLL, you'll get an error code or a null address and your program can figure out what to do with it. The quiet mapping described above does not apply to explicit DLL loading (you guessed it—just like Windows).

You can determine at runtime whether your DLL or program module is running in DOS protected mode by testing the highest bit of the LongInt returned by GetWinFlags. If the high bit is set, your code is running in DOS protected mode; otherwise, it's running in Windows. RTM extends this one Windows function to use a bit that Windows does not use.

To make a single DLL that will work in DOS and Windows, you should not use conditional defines to branch your source code for DOS or Windows support.

For example, RTM does not support LocalAlloc and other local-heap Windows functions that are found in KERNEL. If you would prefer to use the Windows local-heap routines when running under Windows but can make do with normal global-heap allocations in DOS protected mode, you could set up your DLL code to test the GetWinFlags result to determine whether it should call LocalAlloc or GlobalAlloc. This is a rather contrived example, but you get the idea. If there is a special Windows feature that you would like to use under Windows, but you can make do with some other Windows function or your own substitute code under DOS, you can still make one DLL that works in both Windows and DOS.

To make a single DLL that will work in DOS and Windows, you should not use conditional defines (IFDEFs) to branch your source code for DOS or Windows support. The branch decision must be made at runtime, not at compile time.

What are DOS/Windows DLLs good for? The best candidate for a cross-platform DLL is a body of code that performs a useful and nontrivial data-processing service but does not have any sort of visual user interface. User-interface issues are very platform-specific and should be left to platform-specific client programs

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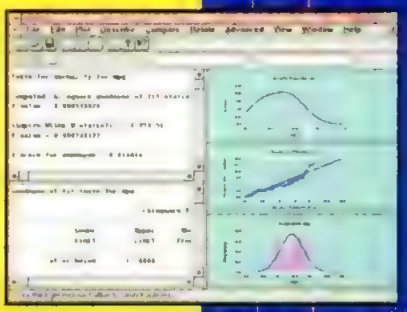

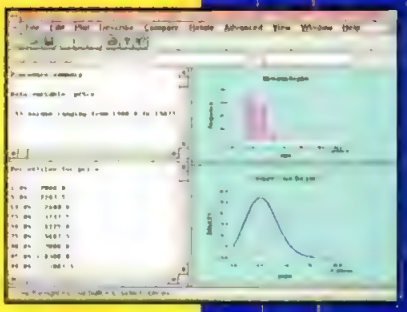

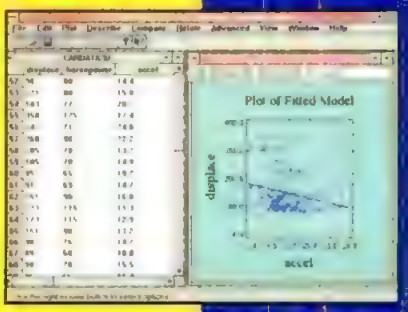

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COMPLEX.DLL

Complete Listing

```
//  Cross-platform DLLs for Windows and DOS
//  Copyright (c) 1993 by Danny Thorpe
//
//  A 'computation engine' DLL for Windows or DOS
//  This DLL performs various arithmetic operations on
//  complex numbers.
//
//  To run this DLL in DOS protected mode, this must be built
//  with the FPINIT.ASM - modified BC++ 3.1 RTL.
//  Memory model should be large.

#include <windows.h>
#include <math.h>
#include <complex.h>

void FAR PASCAL _export Complex(complex& C, double real, double imag)
{
  C = complex(real, imag);
};

double FAR PASCAL _export Real(complex& C)
{
  return real(C);
};

double FAR PASCAL _export Imag(complex& C)
{
  return imag(C);
};

void FAR PASCAL _export AddFloat(complex& C, double R, double I)
{
  C += complex(R,I);
};

void FAR PASCAL _export Add(complex& A, complex& B)
{
  A += B;
};

void FAR PASCAL _export Multiply(complex& A, complex& B)
{
  A *= B;
};

double FAR PASCAL _export Normal(complex& C)
{
  return norm(C);
};


UINT calc_escape(complex& Point,
                 UINT LoopLimit,
                 BOOL ZeroStart)
{
  complex accum(0,0);
  if (!ZeroStart)
    accum = Point;
  for (UINT X = 0; (X < LoopLimit) && (norm(accum) < 4.0); X++)
  {
    accum += Point;
    accum *= accum;
  };
  return X;
};

// The Mandelbrot set is bounded by (-1.8,-1.8) to (1,-1.8), x = real, y = imag.
// For 16 color display, set the color of each point to:
//     PixelColor(x,y) = MandelbrotPoint((x,y), 256) div 16
// Higher looplimits yield finer detail near set boundary
UINT FAR PASCAL _export MandelbrotPoint(complex& Point, UINT LoopLimit)
{
  return calc_escape(Point,LoopLimit,TRUE);
};

// Mandelbrot set (M-set) is a dictionary of Julia sets.  Pick a point near the
// boundary of the M-set, feed it into Julia.  The resulting graph is unique to
// that M-point, but similar to Julia sets graphs of 'nearby' M-points.
// Notice that the only difference between calculating the M-set and the J-set
// is the starting value of the accumulator.
UINT FAR PASCAL _export JuliaPoint(complex& Point, UINT LoopLimit)
{
  return calc_escape(Point,LoopLimit,FALSE);
};


int FAR PASCAL LibMain(HINSTANCE,
                       WORD ,
                       WORD ,
                       LPSTR )
{
  return 1;
}
```

Figure 2: **This is a Windows/DOS cross-platform, protected-mode DLL written in C++. It contains some example complex-number functions.**

(programs that use the DLL) or platform-specific support DLLs.

You can write a DLL to require a call-back function from the client programs that the DLL can call for user-interface or platform-specific assistance. The DLL might use these call-backs to inform the user of some error or to ask for confirmation at a critical juncture. The client program presents or requests the information in a manner appropriate to the platform.

Creating a cross-platform DLL for string concatenation and string searching is probably not worthwhile, since most programming languages have string handling built in already. However, advanced expression-based string searching or grammar-based parsing functions are fairly rare and complex, so these would be worthy candidates for a cross-platform DLL. One of the examples shipped with BP7 is the GREP string-search C code packed into a DLL, used by Windows and DOS Pascal programs to search for expressions in blocks of text.

Since Windows uses the DOS file system, DOS/Windows DLLs can provide file-based data services to client programs. What's the best way to ensure that the DOS and Windows versions of your program use the same file format and file-locking semantics to access your custom data files? Make them use the same code: Put the data file handling code into a DLL, which both the DOS and Windows front ends must use to get data from the file.

Code that makes use of low-level hardware ports or interrupts will be more difficult to arrange in a DOS/Windows DLL, simply because Windows governs hardware access differently from DOS or DOS extenders. You can, however, insulate your DLL engine from the hardware-access differences by creating platform-specific support DLLs for your DLL engine.

For example, Windows has a serial-port communications API, while DOS does not. To make a cross-platform DLL that performs a high-level communications service, such as protocol file transfer, you would need to isolate the low-level serial-port hardware control from the high-level data-stream control. You could achieve this by creating three DLLs: WINCOM.DLL, DOSCOM.DLL, and PROTOCOL.DLL. You would create WINCOM and DOSCOM to implement identical function interfaces that control the serial-port hardware (GetChar, PutChar, DeviceStatus, and so on) but implement them using platform-specific techniques: the Windows API for WINCOM, a DOS serial-communications library for DOSCOM. PROTOCOL would implement the high-level data-stream features using the support DLL functions. Client programs would load and interact with PROTOCOL, and PROTOCOL would check

TEST.PAS
Complete Listing

```
program test;
{$N+,E+}
{
   Sample program illustrating use of cross-platform DLLs
   Copyright (c) 1993 by Danny Thorpe

   This program can be compiled for DOS protected mode
   or Windows target, using Borland Pascal 7.0
}

uses {$ifdef Windows} Wincrt, {$ENDIF} winapi;


type
  TComplex = array[1..sizeof(Double)*2] of byte;

procedure Complex(var C: TComplex; R, I: Double); far; external 'complex' index 10;
function GetReal(var C: TComplex): Double; far; external 'complex' index 9;
function GetImaginary(var c: TComplex): Double; far; external 'complex' index 8;
procedure AddFloat(var C: TComplex; R, I: Double); far; external 'complex' index 7;
procedure Multiply(var A,B: TComplex); far; external 'complex' index 5;
function Norm(var C: TComplex): Double; far; external 'complex' index 4;
function MandelbrotPoint(var C: TComplex; LoopLimit: word): Word; far;
external 'complex' index 3;
var
  X,W: TComplex;
  Step: Double;
  J: Integer;
begin
  Complex(X, 1.23, 4.56);
  writeln('real: ', GetReal(X));
  writeln('imaginary: ', GetImaginary(X));
  Complex(X, 0, -1);
  writeln('Norm of (0,-1) = ', Norm(X):0:0);
  Complex(X, 2, 0);
  writeln('Norm of (2,0) = ', Norm(X):0:0);
  Complex(X, 2, 1);
  writeln('Norm of (2,1) = ', Norm(X):0:0);
  Complex(W, 0, 1);
  Complex(X, 0, 1);
  Multiply(X,W);
  writeln('(0,1) * (0,1) = (',GetReal(X):0:0,',',GetImaginary(X):0:0,')');
  Complex(W, 0, -1);
  Complex(X, 0, -1);
  Multiply(X,W);
  writeln('(0,-1) * (0,-1) = (',GetReal(X):0:0,',',GetImaginary(X):0:0,')');
  Complex(W, 1, 2);
  Complex(X, 3, 4);
  Multiply(X,W);
  writeln('(1,2) * (3,4) = (',GetReal(X):0:0,',',GetImaginary(X):0:0,')');
  writeln;
  writeln('Press any key to continue...');
  readln;

  Complex(X, -1.5, 0.3);
  Step := 1.5 / 20;
  for J := 1 to 20 do
  begin
    writeln(GetReal(X):4:3,' ',MandelbrotPoint(X, 256));
    AddFloat(X,Step,0);
  end;
  writeln('Done!');
end.
```

Figure 3: **This sample Borland Pascal 7.0 client program imports the COMPLEX.DLL functions by function index, using static DLL function references.**

GetWinFlags to decide whether WINCOM or DOSCOM should be loaded. After the load decision has been made, PROTOCOL doesn't care whether it's using the Windows support DLL or the DOS support DLL, because you wrote them to export identical functions.

As you can imagine, this is quite a lot of work. It would probably be worthwhile only if you could use that cross-platform module in several DOS and Windows projects, or if you could use the same support DLLs for other file-transfer protocol DLLs. In short, DOS/Windows DLLs are good for just about any significant data-processing chore that you need done both in Windows and in DOS protected-mode programs.

C DLLS WITH BP7 DOS PROGRAMS It has traditionally been difficult to call C code from a Pascal program and vice versa, mostly because of the significant differences in the respective compilers and runtime libraries. DLLs offer a clean solution to this interlanguage problem. The DLL can contain whatever C runtime library functions the C routines in the DLL need, and the Pascal code can call the DLL through a standard interface. Of course, it works just as easily the other way, too: Windows programs written in C can call Pascal DLLs.

Using a C DLL in the BP7 DOS protected-mode environment can sometimes raise issues unique to C. Usually, problems with Windows DLLs running in DOS are hard to miss—the DLL will either fail to load (and terminate the program) or will fail when called and terminate the program. Here are some common problems and solutions:

Windows' floating-point emulator, WIN87EM, is probably the thorniest obstacle to using C DLLs in DOS protected mode.

- DLL fails to load, and the error "Can't find *xxxx*.DLL" is displayed.

This usually means that the DLL code contains references to Windows modules, such as USER.EXE, GDI.EXE, TOOLHELP.DLL, which aren't in the DOS protected-mode environment.

- DLL loads successfully, but crashes with the error "Invalid entry point."

This means that the C code called a function that RTM mapped to an error routine. The most common cause of this error is a C DLL that uses LocalAlloc or other local-heap routines. These calls may not appear in your C source code but may be buried in the C runtime library. Wherever the calls are, you will need to remove them or place them in environment-sensitive branches (as discussed above) to prevent them from being called when running in DOS.

You can use EXE information tools to figure out what function the DLL is calling that RTM doesn't support. Use TDUMP (shipped with BP7 and BC++) or a similar tool to dump the module reference table and segment fix-up lists of the offending DLL. Look in the fix-up lists for references like KERNEL.5 (a module name followed by a number). KERNEL.5 is the function index of the LocalAlloc routine in the Windows KERNEL. The function indexes of the standard Windows functions are listed in the implementation sections of WINPROCS.PAS and WIN31.PAS. You can use TDUMP or IMPDEF to create a listing of the functions in any DLL. If you are compiling the DLL yourself, a detailed map file from your linker will also list references made to Windows API functions.

Taking the WIN87EM Sting out of Floating Point

Windows provides numeric-coprocessor emulation through a special DLL called WIN87EM.DLL. If a DLL contains floating-point calculations, its runtime library will often contain a static reference to the FPMATH function in WIN87EM.DLL. When such a DLL is loaded with a protected-mode DOS program, RTM (runtime manager) will try to locate a WIN87EM.DLL file on-disk when it loads the DLL. The Windows WIN87EM.DLL will not work in DOS protected mode, and even if it did, you don't have the license to distribute it with your programs. There are three ways to resolve this: eliminate the cause of the problem, eliminate the symptoms of the problem, or modify the RTL to solve the problem.

The first question to ask is "Why is the C DLL using floating-point instructions?" If you can locate the source code that is using floating-point arithmetic, see if floating-point arithmetic is really required. Sometimes isolated use of floating point is not intentional but creeps into the code through oversight or carelessness. If the calculations can be done with integer math or fixed-point arithmetic, it might be easier and more effective to change the source code to avoid 80x87 floating-point math than to attempt one of the alternative solutions below.

For a quick-and-dirty hack, you could create a fake DLL with the same name and function entry points as Windows' WIN87EM.DLL. There are only a few functions exported from WIN87EM, and most runtime libraries don't appear to do much with the return values of these functions. All your fake WIN87EM.DLL has to do is export the same function names (at the same indexes) and have those functions simply return when called. This hack is quite ugly though, and having a fake DLL with the same name as the real Windows DLL is a catastrophe waiting to happen.

The preferred solution is to delve into your C RTL source code to replace the static reference to FPMATH with a runtime-sensitive dynamic binding and to check the rest of the RTL for WIN87EM assumptions or references (for example, floating-point exception handling).

The source code listing of a replacement FPINIT.ASM module for the Borland C++ 3.1 runtime library is included in the WINAPI.ZIP file that you can download from PC MagNet. At load time, this code checks GetWinFlags to determine whether the environment is Windows or DOS. If it's Windows, this code uses LoadLibrary to load the WIN87EM.DLL and GetProcAddress to load the FPMATH function address, and then calls FPMATH to initialize the emulator. At exit time, the code calls FreeLibrary if it loaded WIN87EM.DLL earlier.

This code replacement eliminates the __FPMATH symbol from the RTL name space. This doesn't affect the C RTL itself, but if your C code is using that symbol, it won't compile with this replacement module (or if it does compile, your reference to __FPMATH will suck in WIN87EM.DLL all over again). Also when running in DOS, the C RTL's __FPERR floating-point exception handler is not installed. The main program will trap critical floating-point exceptions, but if your C code relies on getting floating-point exceptions through __FPERR, you will need to add code to hook into the DOS floating-point exception/interrupt chain. __FPERR is installed as normal if the code is running in Windows.

To install this Borland C RTL modification, you'll need to install the Borland C++ 3.1 RTL source code libraries (all of them) included in Borland C++ 3.1. In the \BC31\CRTL\WINLIB directory, rename FPINIT.ASM to FPINIT.OLD, then copy the replacement FPINIT.ASM file into \BC31\CRTL\WINLIB. Follow the instructions in the CRTL directory to set up the necessary environment variables and paths, set your memory model to large (`SET MODEL=L`), run MAKEDIRS to create the directory trees, then run BUILD WINLIB. When the build is finished, a new CWL.LIB will appear in \BC31\CRTL\LIB. Save or rename your normal CWL.LIB file in \BC31\LIB, then copy the new .LIB file to \BC31\LIB. All that's left is to recompile and link your C DLL (using the large model) that you want to use in DOS protected mode!

This Borland C RTL modification has been tested with the accompanying demo program and is required to run the demo DLL in DOS protected mode. Before using this modification in your production code, be sure to test, test, and test some more.

Using one of these three techniques, you can satisfy RTM's loader requirements and run the DLL in Windows or in DOS protected mode on machines with or without numeric-coprocessor hardware.

For each imported function you find in the problem DLL, look for a corresponding function in WINAPI.PAS's implementation section. For example, say you found KERNEL.1 in the dump or in the map file of the problem DLL.

```
procedure FatalExit;
external 'KERNEL' index 1;
```

is in WINAPI.PAS, so KERNEL.1 is supported by RTM and is okay to use in a DOS/Windows DLL.

- DLL fails to load, and the error "Can't find WIN87EM.DLL" is displayed.

Windows DLLs that contain floating-point calculations usually contain a static reference to the Windows 8087 floating-point emulator, WIN87EM.DLL. WIN87EM.DLL is not needed (and won't work) in DOS protected mode—the protected-mode DOS-program EXE provides an 8087 floating-point emulation library. This library will serve the floating-point needs of all the DLLs the program uses.

WIN87EM is probably the thorniest obstacle in using C DLLs in DOS pro-

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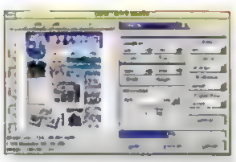

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tected mode. C DLLs that contain a static reference to WIN87EM cannot be run in DOS protected mode without some adjustments to the code or to the environment. See the sidebar "Taking the WIN-87EM.DLL Sting out of Floating Point" for details on how to modify the BC++ 3.1 RTL source code to enable your floating-point C DLLs to run smoothly in DOS and Windows.

• DLL loads but terminates with "Invalid opcode" exception.

Compile the Pascal main program with {$N+,E+} in order to include the 8087 emulation library. Make sure that your main program contains at least one floating-point operation (such as `X := 1.0; X := X * 1.0;`) to force the smart linker to link the emulation library to the EXE and to initialize the coprocessor in the program start-up code.

The main program needs to execute its coprocessor-initializing start-up code before the DLL begins using floating-point arithmetic. Implicitly loaded DLLs' initialization code is executed before the main program begins executing. If your C DLL performs floating-point calculations in its LibMain DLL initialization code, either you should move those calculations to a function that the main program can call after the coprocessor (or emulator) is initialized, or the main program should load the DLL explicitly with LoadLibrary.

A SIMPLE COMPLEX DLL C++ has a full range of math functions that operate on complex numbers, a special class of floating-point numbers with a real portion and an imaginary portion. Pascal doesn't have built-in support for complex-number arithmetic, but C++ does, so we'll create a small C++ DLL to provide complex-number operations for a Pascal program.

For space reasons, this will be a small and trivial library (violating the nontrivial rule mentioned earlier, just to illustrate the point), but it illustrates the topics raised in this article: floating-point operations in a cross-platform C DLL used by a Pascal program.

The C++ COMPLEX.DLL in Figure 2 contains functions that initialize a complex number, extract the real and imaginary parts of a complex number, add to the real and imaginary portions of a complex number, add two complex numbers, multiply two complex numbers, and take the normal of a complex number (the *normal* of a number is the sum of the squares of the real and imaginary parts—a measure of the magnitude of the complex number).

We provide this library not as a general-purpose complex-arithmetic engine, but to show a working cross-platform DLL. There are also bonus functions that calculate the escape velocities of points in and around the Mandelbrot and Julia fractal sets, which live in the complex plane. If a complex number put into the Mandelbrot or Julia algorithm gets larger over many iterations, then the number is said to *escape* the fractal set. The number of iterations it takes for the complex number to grow past a threshold (4) is the escape velocity of the number. If a complex number gets smaller or oscillates around a particular value, then the number is said to be *trapped* by the algorithm and therefore included in the fractal set. Points within the fractal set aren't particularly interesting. What makes the pretty pictures are the wondrous variation and symmetry of escape velocities near the edge of the fractal set.

DLLs are a powerful way to enhance your applications and streamline code among programs and across programming languages.

Pascal doesn't support functions whose results are arbitrary structures larger than 4 bytes, and a complex number consists of two 8-byte double values. Thus, the first parameter of each of the complex functions is a reference parameter, which is used to return the result of the calculation to the caller. As noted in the source code comments, the data type the Pascal program sets up to receive the complex return values is a featureless array of bytes. If we used a record of two doubles, we might be tempted to modify those fields in the Pascal program, but in this demo, the client is not supposed to touch the DLL engine's private data.

The C++ code is compiled into a Windows DLL using the BC++ 3.1 large-model runtime library (CWL.LIB), modified to remove the static reference to WIN87EM.DLL, as discussed in the sidebar. The BC++ RTL does not actively use Windows local-heap functions (which RTM doesn't support) in the compact, large, and huge memory models. However, DLLs compiled in other memory models may run into problems with local-heap calls inside the C++ RTL.

The Pascal client program in Figure 3 imports the COMPLEX.DLL functions by function index, using static DLL function references. C++ mangles the given name of a function to include parameter-type information, which makes calling a C++ DLL function by name rather difficult for anything but a C++ compiler. Loading the DLL functions by number avoids the name-mangling issue.

The Pascal client program calls several of the COMPLEX functions and displays the results of the calls for verification. This Pascal program can be compiled as a protected-mode DOS application or a Windows application, and the program will run the floating-point–laden C++ DLL on machines with or without a numeric coprocessor.

Dynamic link libraries are a powerful way to extend your applications and improve the efficiency of code among programs and across programming languages. The Borland DOS extender in Borland Pascal 7.0 enables you to use Windows DLLs with DOS protected-mode applications. For nonvisual, workhorse-engine DLLs, it's not difficult to write a DLL that can be used by Windows and DOS programs alike. By following these guidelines and using the Windows functions listed in WINAPI.PAS, you can open your Windows DLLs to a whole new customer base: DOS protected-mode programmers. □

DANNY THORPE IS A SENIOR QUALITY-ASSURANCE ENGINEER FOR THE PASCAL DEVELOPMENT TEAM AT BORLAND INTERNATIONAL. HE CAN BE REACHED BY COMPUSERVE (76646,1035) OR BY INTERNET (DTHORPE%IPSWITCH@BORLAND.COM).

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Utilities

BY DOUGLAS BOLING

CONFIX.SYS: Control at Boot Time

One of the most troublesome aspects of setting up a PC is the CONFIG.SYS file. A seemingly trivial change to one line can cause your machine to lock up tight. Error messages scroll by at warp speed, and finding the problem may require multiple reboots.

CONFIX, a device driver that lets you pause your PC, change the video mode, and perform other useful commands at boot time, makes editing and debugging CONFIG.SYS much easier. While the latest versions of DOS provide some of CONFIX's commands, CONFIX works on all versions of DOS from 2.0, and its memory-access commands are not available in any version of DOS.

You load CONFIX by listing it on a DEVICE= line in CONFIG.SYS. The syntax for CONFIX is

```
DEVICE=[path]CONFIX.SYS command
 [parameters]
```

A list of the CONFIX commands is shown in Figure 1.

CONFIX and its assembly language source can be obtained free of charge by downloading the files from our on-line service—PC MagNet—or by mail. See the sidebar "Guide to Our Utilities & How to Get Them" for details.

BATCH LANGUAGE COMMANDS The inspiration for CONFIX came to me one day while I was having trouble with EMM386. The screen was scrolling so fast during the boot, I could not read an error message. What I needed was a PAUSE command in CONFIG.SYS, so I wrote CONFIX.

The CONFIX's PAUSE command causes CONFIX to stop and wait until a key is pressed, which effectively halts the DOS boot process. The one parameter for this command is the message CONFIX prints before waiting for the keystroke. If no message is included on the command line, CONFIX prints the standard DOS message, "Press any key when ready . . ." used by the batch file PAUSE command.

Since DOS has the irritating characteristic of capitalizing the parameter line before calling a device driver, CONFIX handles string parameters in a special way: All characters enclosed in double quotes are converted to lowercase, undoing DOS's dirty work. Any characters outside the double quotes will become capitalized. If you want to display a double quote, place consecutive double quotes on the line and CONFIX will recognize this as a quote character. So the command

Top 10 Utilities

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1	**DIRMATCH** - *Compares directories*
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3	**WINCMD** - *Command file interpreter*
4	**CLIPST** - *Extends the clipboard*
5	**DEFRAGR** - *Defragments disks*
6	**FNTPRN** - *Catalogs your fonts*
7	**INCTRL** - *Installation control*
8	**CHKFRAG** - *Checks fragmentation*
9	**CHANGER** - *Changes look of desktop*
10	**PCSPOOL** - *Print spooler*

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

```
DEVICE=CONFIX.SYS PAUSE This is
capitalized. T"his is not."
```

will produce this pause message:

```
THIS IS CAPITALIZED. This is not.
```

CONFIX's ECHO command is similar to the like-named batch file command in that it displays a line of text on the screen. While seemingly trivial, it provides great power if you use it with ANSI.SYS. By installing ANSI.SYS and then using the ECHO command, you can send ANSI.SYS command strings to control display characteristics such as screen colors and cursor position.

The one parameter of the ECHO command is the line of text to be displayed. If no text is included on the line, a blank line is displayed. When sending control strings to ANSI.SYS, remember to use quotes to control the capitalization of the characters, since control strings are sensitive to case. For example, to set the colors to yellow on blue, you would use the command

```
DEVICE=CONFIX.SYS ECHO ^V[33;44;1"m"
```

Where ^V stands for the escape character. You'll need an editor capable of inserting the escape character to do this, for example, DOS's own EDIT (press Ctrl-P, then Esc).

The REM command, for *remark*, essentially performs no action. Any text on the command line past the REM command is ignored by CONFIX.SYS. This allows users running DOS versions prior to DOS 5.0 to insert remarks in their CONFIG.SYS files.

The PRTSCR command dumps the screen to the printer. This command has the same effect as pressing the PrtSc key on the keyboard. The difference is that PRTSCR lets you more easily control when the screen is printed. Since the screen is printed exactly when the PRTSCR command is processed, you don't have to worry about pressing the PrtSc key at the exact time DOS processes the CONFIG.SYS file.

DISPLAY-RELATED COMMANDS Another handy feature of CONFIX is that it lets you set the screen to display more than the standard 25 lines of text. The extra

lines allow you to see more of the install messages from drivers before those messages scroll off the top of the screen.

CONFIX's SMLFONT command switches the video mode on EGA and VGA displays to display characters in an 8- by 8-pixel font. On an EGA this results in a screen displaying 43 lines, while on a VGA the screen will display 50 lines. The command NORMFONT will switch the screen back to 25-line mode for EGA and VGA systems.

In case you need more flexibility, there is the VIDMODE command, which lets you switch to any video mode supported by your adapter. The advantage of VIDMODE is that it gives you access to nonstandard video modes that are available only on specific adapters. For example, I can switch my ATI Technologies video card to 100 columns by 42 rows with the command

```
DEVICE = C:\UTIL\CONFIX.SYS
 VIDMODE 54
```

Notice that the video-mode number is specified in hexadecimal (base 16). This is because most manuals list the different video modes in hexadecimal format. In fact, all the numeric parameters in CONFIX are specified in hexadecimal.

CONFIX also provides a CLS command so you can clear all messages once the drivers are loaded.

LOCK STATE COMMANDS The NUMLOCK, CAPSLOCK, and SCROLLLOCK commands let you modify the often annoying default states of the lock keys. Each of these commands takes one parameter—ON or OFF—to indicate whether the lock is to be set or cleared. For example, to clear the NumLock, the command would be

```
DEVICE = C:\UTIL\CONFIX.SYS NUMLOCK
 OFF
```

This example assumes that CONFIX.SYS is located in the UTIL directory on the C: drive.

MEMORY ACCESS COMMANDS The last set of commands is oriented toward programmers. These commands may not be used frequently, but they provide some very important abilities that aren't available otherwise: to view and modify the state of the machine during the boot process. These commands are probably most useful as an aid in debugging device drivers.

Allowable Commands for CONFIX.SYS

Batch language commands	
PAUSE	Pause processing of the CONFIG.SYS file
ECHO	Display a line of text on the screen
REM	Perform no action
PRINTSCR	Send the current display contents to the printer
Display-related commands	
SMLFONT	Select the 43/50 line mode on EGA and VGA displays
NORMFONT	Select the 25 line mode on EGA and VGA displays
VIDMODE hex number	Set the video display mode
CLS	Clear the screen
Lock-key state commands	
NUMLOCK ON|OFF	Set or Clear the NumLock state
CAPSLOCK ON|OFF	Set or Clear the CapsLock state
SCROLLLOCK ON|OFF	Set or Clear the ScrollLock state
Memory-access commands	
PEEK segment, offset, [num-bytes, [1 (for word)]]	Read and display the contents of a memory location
POKE segment, offset, byte1 [, byte2, ..., byte8]	Write a series of bytes to memory
IN port	Read an I/O port
OUT port, byte	Write to an I/O port

***Figure 1:* The CONFIX.SYS commands fall into four broad categories: batch language, display, lock-key state, and memory access.**

The first advanced command, PEEK, displays a series of bytes read from memory. The command takes four parameters; the third and fourth are optional. The first two are the segment and offset of the memory address to read, the third parameter is the number of bytes to read, and the fourth parameter determines how the data read will be presented on the screen. If the third parameter is omitted, 1 byte will be read. If the fourth parameter is 1, the data returned is displayed as a series of words (each word is 2 bytes each) instead of individual bytes. If the fourth parameter is omitted, the data is displayed as individual bytes.

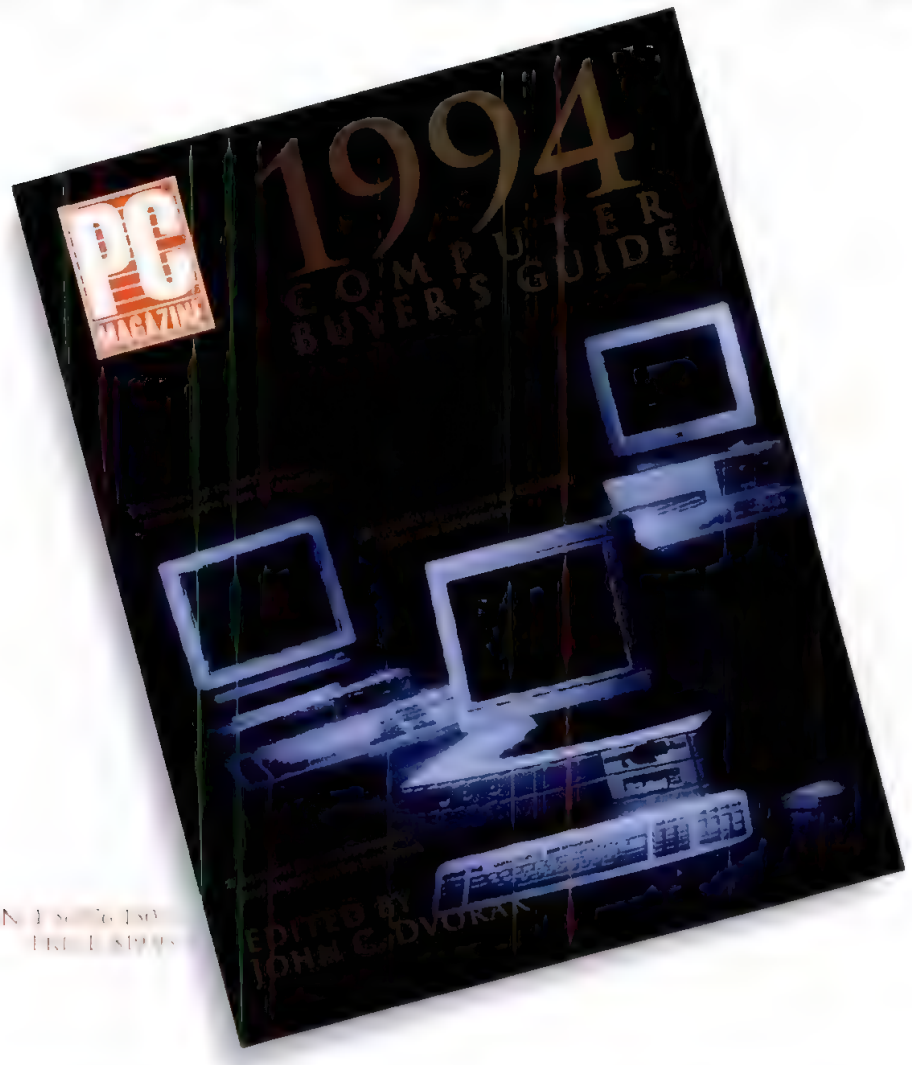
One application for the PEEK command (and the IN command to be discussed below) is to track down just when something was changed during the boot process. For example, say two drivers were competing for an interrupt vector. You can see where the interrupt vector is pointing after the boot by using DEBUG or some other utility, but there is no way to see where that vector was pointing before the second driver redirected the interrupt. To solve this problem, just put in a PEEK command followed by a PAUSE after each driver statement in your CONFIG.SYS file. For example, to monitor the multiplex interrupt vector, the command would be as follows:

```
DEVICE = C:\UTIL\CONFIX PEEK 0,
 BC, 4, 1
```

This tells CONFIX to display the 4 bytes starting at segment 0, offset BC (hex). The last parameter, 1, tells CONFIX to display the 4 bytes as two 16-bit words, which is better for inspecting word or double-word values, such as interrupt vectors.

The POKE command performs the reverse of PEEK by writing data to memory. As with PEEK, the first two parameters are the segment and offset of the memory address. The remaining parameters, up to 8 bytes, are the values to write to consecutive memory locations starting

FOR THOSE HARD CHOICES.



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DRIVER REQUEST STRUCTURE

Complete Listing

```
init_req                struc
    irLen               db      24          ;Size of structure
    irUnit              db      ?
    irFunction          db      0           ;Requested function
    irStatus            dw      ?           ;Returned status
    irReserved          db      8 dup (?)
    irUnits             db      ?           ;Number of block drives
    irEndAddress        dd      ?           ;End addr of driver
    irParmAddress       dd      ?           ;Ptr to cmd line parms
    irDriveNumber       db      ?           ;1st drive number
    irMessageflag       dw      ?           ;Error word
init_req                ends
```

Figure 2: **A pointer to this structure is passed to the Init function. An initialization routine is called when the driver is first loaded.**

with the specified segment and offset. Note that the POKE command can be quite dangerous since writing to the wrong place in memory can cause your system to lock up.

One useful purpose of the POKE command would be to write the I/O address of your COM3 and COM4 ports. Many BIOSes only look for two serial ports when the system starts. With the POKE command, you can write the addresses of the third and fourth serial ports to their appropriate places in the BIOS data area. For example, lets say you have a serial card configured for the COM3 port with an address of 3E8h. To write this address into the BIOS COM3 pointer, the command would be as follows:

```
DEVICE = C:\UTIL\CONFIX POKE 40,
 4, E8, 3
```

This command says to write 2 bytes, E8 and 3, starting at segment 40 (the BIOS data area), offset 4 (the location of the COM3 pointer). The data values E8 and 3 are reversed because Intel processors store data in memory with the less significant byte in the lower memory address.

The IN and OUT commands provide the ability to read and write to the hardware I/O ports in the system. I/O ports are mainly used to communicate with hardware peripherals attached to serial and parallel ports, such as modems and printers. The IN command takes one argument: the address of the I/O port to be read. The address of the I/O port must be entered in hexadecimal. The byte read from the I/O port is then displayed on the screen, also in hexadecimal format. The OUT command takes two arguments: The address of the I/O port to write to and the data to write. Be careful what you write directly to a port as you can inadvertently lock up your system.

The IN command is handy for inspecting the state of I/O devices such as parallel ports or disk controllers. OUT, on the other hand, can be used to configure a device before another driver is loaded. While neither of these commands will be used very often, there may be some instances where they could come in handy. For example, if you want to see how the serial chip for COM1 is configured, you could read the control register at I/O address 3FB with the command

```
DEVICE = C:\UTIL\CONFIX IN 3FB
```

The OUT command could be used to change the configuration of the same COM1 serial chip with the following command:

```
DEVICE = C:\UTIL\CONFIX OUT 3FB, 0B
```

which would configure the chip for an eight-bit data word with one stop bit and odd parity checking.

Unlike a standard device driver, CONFIX does not stay resident in memory once loaded; it performs the command on its command line and then terminates.

INSIDE CONFIX CONFIX is written as a device driver so its functions are accessible at boot time. Unlike a standard device driver, CONFIX does not stay resident in memory once loaded; it performs the command listed on its command line and then terminates. This means CONFIX can be used repeatedly in CONFIG.SYS without taking up valuable memory once the boot process is complete. In effect, CONFIX is just like any other transient program that runs under DOS. The only difference is that CONFIX is run while DOS is still initializing.

DOS uses device drivers to isolate it from the nitty-gritty of low-level access to hardware devices, such as disk drives or printers. DOS talks to a device driver using a small set of around 20 commands, and the driver in turn deals with the disk or the printer through the BIOS or through a nonstandard interface. The device driver concept, borrowed from a similar idea in Unix, is one of the primary reasons for the success of DOS. With a simple device driver model, hardware manufacturers were free to design the best hardware, then simply write a DOS device driver to interface that hardware to the huge installed base of DOS machines.

There are two distinct types of DOS device drivers: character and block. Character device drivers deal in streams of individual characters and are used on devices such as printers, where DOS writes a series of characters to the device. When DOS reads from a character device, only the next character in the stream is accessible. If, for example, the fifth character has the required data, the first four characters must be read before the fifth can be read.

A block driver is different from a character driver in that data from a block device is addressable. That is, DOS can read or write data in individual chunks, or *blocks*, in any order. Block drivers are used to interface with disk drives, where data must be addressable on a sector-by-sector basis. CONFIX is a character mode

Take Command of Windows Contest Winners

Gerald Werner, of Marshfield, Wisconsin, took top honors in the "Take Command of Windows" contest sponsored by ZiffNet and *PC Magazine*. Werner's program, SSCLOSE was chosen as the most orginal and useful application of Doug Boling's WINCMD program. SSCLOSE continually lurks in the background, looking for the password dialog box from a password-protected screen saver. If the box remains on-screen too long, SSCLOSE automatically clears it from your screen. Says Boling, who judged the contest, "This is the kind of script I wrote WINCMD for."

For his efforts, Werner received a Sony Discman portable CD player and a *PC Magazine* racing jacket. Runners-up were BUTTON, by Donald Badowski; TOBY, by Richard Oakland; and AUTOSAVE, by Chris Hildebrandt.

SSCLOSE and all of the runner-up scripts can be downloaded from the Utilities/Tips Forum on ZiffNet. Search on the keyword WINCMD. The original WINCMD utility is also available on-line in ZiffNet's Software Library. Just type GO SOFTLIB at any CompuServe prompt (!).

device driver, but since it doesn't stay resident, it could have just as easily been written as a block driver.

DOS device drivers are constructed differently from standard DOS programs. Instead of having an entry point that is called when the program is loaded and a standard termination call (such as the DOS Terminate Program call) to terminate the program, a device driver is loaded and then repeatedly called when DOS needs to access the device with which the driver interfaces.

Even the process of calling the device driver is different from a standard DOS program. Instead of jumping to an entry point, DOS first makes a far call to a routine in the device driver, called the *strategy* routine. The only function of the strategy routine is to save a pointer to a structure that contains the parameters to be passed to the device driver. The driver's strategy routine saves this pointer and returns; no other action is performed.

After the strategy routine returns, DOS calls the driver's interrupt routine. The name *interrupt* has nothing to do with hardware or software interrupts often used in the DOS environment; it is simply the name given to this routine in the device driver. The interrupt routine is where the work of the device driver is performed. The strategy routine saves a pointer to the parameter structure, and the interrupt routine reads the necessary parameters from this structure.

The most important parameter passed is a function number that indicates what function DOS has requested of the driver. A good example is the Init function, which is called only once by DOS when the driver is first loaded. During the Init function, drivers perform any necessary initialization tasks.

The structure passed to the Init function is shown in Figure 2 and contains two fields of interest. The irParamAddress field contains a far pointer to a buffer that contains the DEVICE= line in the CONFIG.SYS file that caused the driver to be loaded. This pointer points to the first character after the DEVICE= string on the line. Note that this includes the device driver name as well as any command line parameters. This is different from the command line buffer in the PSP (program segment prefix), which only contains the parameters on the command line *after* the program name. The command line is terminated by a carriage-return character (0D hex).

The CONFIX functions aren't complex, but the ability to execute them during the initialization stages of DOS makes them useful.

The irEndAddress field was uninitialized in versions of DOS up to DOS 4.0. DOS 5.0 and 6.0, however, initialize the field with the *segment:offset* address of the last available byte in RAM that is linearly accessible. Any memory between the current address of the driver and the address in the irEndAddress field is available to the driver. This field is handy when drivers are loaded in an upper memory block (UMB), where the amount of memory space that can be reserved is limited. Drivers can use this pointer to determine if there is enough memory for initialization.

When the driver initialization is complete, the irEndAddress field is filled in with the address of the last byte of memory that the driver has claimed. The amount of memory reserved by the driver must be enough to satisfy it for as long as DOS is running, since device drivers can't allocate more memory after they have been installed.

If a driver detects an error condition during the Init call, it can abort its installation by setting the irEndAddress field to CS:0. This signals DOS to remove the driver from memory when the Init call returns. CONFIX uses this feature of DOS to unload itself after it has completed its work.

CONFIX FUNCTIONS Implementing the CONFIX functions is fairly straightforward. Functions like ECHO and PAUSE simply print a string using the DOS Display Character function (int 21h, function 02). PAUSE also uses the DOS Get Character function to wait for a key. While it might seem that using the Read (int 21, function 3F) and Write (int 21, function 40) functions would be a more modern approach, remember that a device driver is limited in the DOS calls that can be made during initialization. The Read and Write functions are not available at boot time.

CONFIX calls the video BIOS (int 10h) for the functions involving the display. SMLFONT checks for EGA or VGA, and if present, selects the 8- by-8-pixel font using the Load ROM 8-by-8 Font function (int 10h, function 11H, subfunction 12h). The VIDMODE function simply calls the Set Video Mode function (int 10h, function 0). The CLS function

clears the screen by calling the Scroll Window Up function (int 10h, function 6) with the number of rows to scroll set to 0. When called this way, the Scroll Window Up function simply initializes the screen area designated by the call with blank characters.

The three lock-key functions, SCROLLLOCK, CAPSLOCK, and NUMLOCK, change the state of the lock keys by setting or clearing the appropriate bits of the keyboard-status byte at offset 17h in the BIOS data area. CONFIX does not have to worry about the status lights, since in most cases the BIOS automatically updates the lights on the keyboard to reflect the state of the corresponding bits in the keyboard status byte.

CONFIX provides a unique solution to a nagging problem. While the CONFIX functions themselves are not very complex, the ability to execute them during the initialization stages of DOS makes them useful. The many different commands available also provide flexibility. You may find uses for CONFIX that I have not even considered.□

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF PC MAGAZINE.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

CONFIX Command

PURPOSE: CONFIX is a device driver that lets you issue commands such as PAUSE or CLS early in the boot process. CONFIX's commands aid you in locating and fixing errors in your CONFIG.SYS file.

SETUP: To use CONFIX, simply copy CONFIX.SYS to your hard disk and load it in CONFIG.SYS with a DEVICE= statement. The CONFIX commands are PAUSE, ECHO, REM, PRINTSCR, SMLFONT, NORMFONT, VIDMODE, CLS, NUMLOCK, CAPSLOCK, SCROLLLOCK, PEEK, POKE, IN, and OUT.

REMARKS: The CONFIX commands fall into four main groups: batch language, display, lock-key state, and memory access.

The batch commands (PAUSE, ECHO, REM, and PRINTSCR) let you pause the boot process to give you time to read the on-screen messages, echo (display) text on the screen, or print the information on the screen. CONFIX's REM command lets you add comments to your CONFIG.SYS file if you're using a version of DOS prior to DOS 5.0.

The display commands (SMLFONT, NORMFONT, VIDMODE, and CLS) let you switch into a compressed text mode so you can see more of the messages before they scroll off the screen. You can revert back to 25-line mode with NORMFONT, and clear the messages from the screen with CLS.

The lock-key state commands (NUMLOCK, CAPSLOCK, SCROLLLOCK) let you change the default lock status of these keys.

The memory access commands (PEEK, POKE, IN, and OUT), while mainly of interest to programmers, provide some unusual capabilities. PEEK lets you read and display the contents of a memory location, while IN lets you read an I/O port. The POKE and OUT statements let you write to a memory location or I/O port, respectively.

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TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

Peripherals

TEST DRIVING A MONITOR

PC MAGAZINE: Since you'll spend countless hours looking at your monitor, it's important to get a good one when you buy a new system or upgrade an old one. Even monitors of the same make and model sometimes vary significantly in image quality, so you should check out the specific unit you intend to buy. But how do you test drive a monitor in the computer showroom before you take it home?

Naturally, diagnostic utilities that produce a wide range of images can tell you a lot about monitor quality. One of the best of these is DisplayMate Professional, from Sonera Technologies (P.O. Box 565, Rumson, NJ 07760; 800-932-6323, 908-747-6886; fax, 908-747-4523). Since computer salespeople are sometimes uneasy about letting you run your own software on their demo units, however, you may not want to walk into the store conspicuously armed with various diagnostic programs.

Fortunately, you can learn most of what you need to know about a monitor's quality by running two simple tests that use standard Windows programs. Since Windows can produce images of various resolution, you can even test the monitor in high-resolution modes if you choose. (Bear in mind, however, that most computer stores don't change the Windows configuration from the default VGA mode, so you may have difficulty finding the required driver disks for high-resolution modes that are not already installed on the system.)

Start by bringing up the Windows Paintbrush program (it's normally in the Accessories group) and maximizing the program to fill the screen. Keep the default black drawing color. Select the Fill tool (the paint roller) and click on the workspace to fill it with black. Now select the vertical scroll bar and move the slider all the way to the bottom. This will reveal a white area, which you should also fill with black. Move the horizontal scroll bar all the way to the right and fill the white with black again. Finally, move the vertical scroll bar back to the top. This will reveal a remaining white block, which you also fill with black. Return the vertical scroll bar to its bottom position.

You can learn most of what you need to know about a monitor's quality by running two simple tests that use standard Windows programs.

Now change the drawing color to white by clicking on the white square in the palette at the bottom of the screen. Select the smallest line width, which will produce a 1-pixel-thick line. Choose the Rectangle Drawing tool in the left column, not the Filled Rectangle tool in the right column, and draw a box that very nearly fills the work area. Move the scroll bars back to the top and left positions and draw another box that fills the newly opened space. Then press Ctrl-P to view the image on the full screen.

You should see two intersecting white rectangles on a black screen. (Depending on your Windows driver, you may see white bands at the top and bottom as well.) The rectangles will tell you much about the monitor's quality.

First, look closely at the lines to see if they are truly white. If the monitor has convergence problems, you'll see colored edges along the lines. In the worst cases, you'll see separate lines, such as a red line beside a cyan line. A faint tinge in a few areas is not likely to degrade the image quality appreciably, but severe alignment problems will blur the images you'll be working with later.

Check that the lines are straight, especially along the edges. *Pincushioning* (a curvature along the edges of the image) and similar forms of distortion can result in screen images that range from annoying to impossible to use.

Check also for equal widths between the vertical and horizontal lines. VGA and higher resolutions produce approximately square pixels, so the line widths should be the same. On some monitors,

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however, the verticals are noticeably thinner, and this too reduces image quality.

If possible, repeat this Paintbrush test at all the screen resolutions you intend to use. The monitor performance can vary at different resolutions, with some units worse at lower resolution, others worse at higher resolutions. Note, however, that to change resolutions you generally must change the Windows driver, using either the Windows Setup program in the Main Program Manager group or the DOS SETUP program in the Windows directory. This will often require the use of either driver disks for the graphics adapter,the original Windows disks, or both. To be on the safe side, contact a salesperson to get permission before you start changing the Windows configuration and make sure the necessary disks are on hand.

If a monitor fails to meet your expectations in any of these tests, try them again on another unit of the same model, since the problems might simply be the result of individual unit variations.

You can also check the bandwidth of the monitor—that is, its ability to handle all the information your video card will throw at it. To test this, run the Windows Notepad using the highest resolution you intend to use. Maximize the application and then fill the first line with capital *M*'s. Copy this line to the Clipboard and then paste it repeatedly until you fill the whole screen with *M*'s.

Now look closely between the vertical strokes of the letters. If the monitor has sufficient bandwidth for the signal, you'll see sharp black lines separated by areas of clear white. If the monitor is not up to the task, however, the area between the letters will be noticeably gray, especially when compared with the solid-white horizontal bands between the lines. If the monitor fails this test, you should probably look at another model altogether, since this kind of problem is more likely to be part of the overall design than individual unit differences.

—Alfred Poor

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.
Frank J. Derfler, Jr., is senior networking editor and the author of the *PC Magazine Guide to Connectivity.*
Alfred Poor is a contributing editor and the author of *New Life for Old PCs.*
Jeff Prosise is a contributing editor and the author of the *PC Magazine Guide to DOS 5 Memory Management.*
Sal Ricciardi is a contributing editor and the author of the recent *Running FoxPro* books from Microsoft Press.
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Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities.*

A GHOSTLY PROBLEM

❓ Enclosed is a form that I photocopied and then filled out by printing the items that need to be entered with my laser printer. To my surprise, this simple process transformed my printer into a quasi–copy machine that produced a faint but clearly visible shadow of each of the preprinted lines of the form on the printed document. The ghost of the form continued to appear down the length of a number of successive blank pages, ruining them all. This strikes me as being a serious flaw in the printer's design. Shouldn't you in the computer press point out this problem instead of raving about the printer's quality?

Russell Stepanchak
Columbia, Pennsylvania

▶**PC MAGAZINE:** We edited out the name of Mr. Stepanchak's printer, because the problem he describes is not unique to any single machine. The problem arises when toner is transferred from photocopied forms to laser printers.

Typically, toner starts as a plastic powder—a styrene acrylate copolymer. The plastic is melted so that other substances can be added to give the toner its desirable qualities. For example, carbon is added to make the toner black. Iron oxide (a fancy name for rust) is added to

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the mix to provide magnetic properties and to alter the toner's ability to hold an electrical charge.

There are many subtle and important differences between specific toner formulations, however. The print engine speed and toner delivery system largely affect the required toner attributes. The toner must accept enough of an electrical charge so that it will be attracted to the photoconductive drum, yet not so much that it won't transfer sufficiently to the paper. Once on the paper, it must melt when passed through the fuser assembly but just enough to adhere adequately to the paper's surface, without getting so soft that it blurs, smudges, or, worst of all, transfers to the fuser rollers.

The problem Mr. Stepanchak describes is the result of running a sheet of paper with toner deposited by some other printer or photocopier through a laser printer. Some of the toner on the page got remelted and was transferred to the fuser roller, turning the roller itself into an offset printer drum. The ghost of the original image can mar the dozen or more sheets that follow it.

The way to avoid such difficulties in the future is to transfer the image without running a toner-covered page through the printer. For example, you could scan the original form and fill it out on your computer screen. Or you could photocopy the original and then photocopy your answers onto the copy.

If you do encounter this problem and need to clean your printer, focus on the fuser rollers (top and bottom) first. A light oil may be sufficient to clean off the rogue toner, but turn the printer off to let the fuser assembly cool before you start—the fuser rollers can be *very* hot. If the toner has migrated all the way to the photoconductive drum, there is no easy way to clean it off. You can try printing a page of solid black, and if that doesn't clear up the problem, feed the all-black sheet through the printer once again without printing anything (send a form-feed to the printer) to sweep the paper-handling path of stray toner. Feed the paper black side up if your ghosts are on the front of the page, and black side down if they are on the back. If this doesn't work, try running a dozen sheets through without printing anything. If the problem still persists, you may need to replace your photoconductive drum.
—Alfred Poor

Word Processing

OPENING NOTEPAD WITH WORD WRAP

❓ How can I modify the Windows 3.1 Notepad so that it defaults with word wrap turned on?

Daniel Owen
New York, New York

▶**PC MAGAZINE:** If Notepad lets you change its defaults, that feature is well hidden. Fortunately, however, you can achieve the same effect by other means. There are several macro and batch-file utilities available for Windows, most of

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which can start Notepad and set word wrap for you automatically. One example is *PC Magazine*'s WINCMD utility, which is available on PC MagNet (for more information, see our April 27, 1993 issue). A WINCMD file can handle the task with just two lines:

```
NOTEPAD
SENDKEYS("%EW")
```

Here, the first line starts Notepad, and the second sends the program the keystrokes Alt-E and W, just as if you typed them yourself. (Depending on the speed of your system, you may also want to add a DELAY(*x*) command before the SENDKEYS command. The *x* designates the number of milliseconds delay, from 100 through 65,355.)

If you don't have WINCMD or another reasonably sophisticated macro or batch file utility, the easiest route is to use the Recorder accessory that comes with Windows. Recorder will let you create a macro that will open Notepad and change its word wrap setting. If you always open Notepad with the macro, Notepad will always open with word wrap on.

To create the macro, go to Program Manager and start the Recorder program, which will be in your Accessories group unless you've moved or deleted it since you've installed Windows. If you've previously used Recorder and have already created a macro file that you generally want active, open that file as well. I'll assume that you don't have such a file and that this is the first macro you're recording.

Choosing MacroRecord will bring up the Record Macro dialog box. You can accept most of the default settings, leaving the Playback choices set to Same Application and Fast speed, the Enable Shortcut Keys box checked, the Continuous Loop box not checked, and Record Mouse set to ignore the mouse. Enter an appropriate macro name, such as Notepad, and a shortcut key, such as Ctrl-Alt-Shift-N. (You specify the shortcut key by checking any combination of the Ctrl, Shift, and Alt boxes and then either typing in an alphanumeric key in the text box above or opening the attached drop-down list and picking a function key, such as Tab or the like.)

Be careful when choosing a shortcut key. The macro will play back from within any Windows program, and you don't want to open Notepad accidentally when you mean to give a command to another program you're using. If you do choose a shortcut key that you later find you need elsewhere, however, you can always change it by opening the Recorder, highlighting the macro name, choosing Macro Properties, and using the Macro Properties dialog box to redefine the keystroke.

When you finish making entries in the Record Macro dialog box, choose the Start button. Recorder will automatically change to a minimized icon and return you to your previous program—in this case, Program Manager. (If your screen layout lets you see iconized programs at the bottom of the screen, you'll see the Recorder icon blinking, indicating that it is actively recording a macro.)

Recorder will let you create a macro that will open Notepad and change its word wrap setting for you.

Next, in Program Manager use keyboard commands to select FileRun. Type `Notepad` as the command line and choose OK. When Windows opens Notepad, type Alt-E then W, to choose Edit and toggle Word Wrap on. Then immediately switch to Recorder by pointing with the mouse and clicking or by using Alt-Tab to cycle back to the Recorder program. (Don't use Ctrl-Esc; if you do, Recorder will record those keystrokes as part of the macro.) When Recorder brings up its Record dialog box, accept Save Macro and choose OK. If this is the first macro you've ever created, Recorder will respond with its Save As dialog box set to save the new file in the Windows directory. Enter an appropriate filename, accept Recorder's defaults for the Windows directory and for the .REC file extension, and choose OK.

If you've done everything right, you'll now be able to open Notepad and turn word wrap on in one step, simply by running the macro. To test the macro, close the current Notepad window (to avoid confusion) and type the shortcut key you defined for the macro. Recorder should open Notepad for you and set word wrap on; you'll need to open the Edit menu manually to verify that there is a check next to the Word Wrap item.

If you've made a mistake along the way, you'll have to run through the entire procedure again, since Recorder doesn't provide any macro-editing capabilities. (Note, however, that Recorder won't let you assign the same keystroke to the new macro unless you delete the defective macro before recording the new one.)

To make this macro useful, you'll also need to set up Recorder so you don't have to start the utility manually and then load the appropriate macro file each time you start Windows. Otherwise, using the macro will actually be more work. Fortunately, you can automate both steps.

To set Recorder to load the right macro file automatically, select the Recorder icon in Program Manager and choose FileProperties. By default, the entry in the Command Line text box should read RECORDER.EXE. Simply add a space after the program name and then type in the name of the macro file you want Recorder to load automatically. If the file is DEFAULT.REC, for example, change the Command Line entry to

```
RECORDER.EXE DEFAULT.REC
```

After you OK this change, Recorder will automatically load the macro file whenever you start Recorder from the Program Manager icon.

All that remains now is to tell Windows to load Recorder automatically whenever you start Windows. The easy way is simply to drag the Recorder icon into your Startup program group. Alternatively, you can select the Recorder icon and choose File Move. Then pick the StartUp group in the To Group list and choose OK. Once in the StartUp group, Recorder will load automatically every time you load Windows and will automatically load the designated macro file as well.—*M. David Stone*

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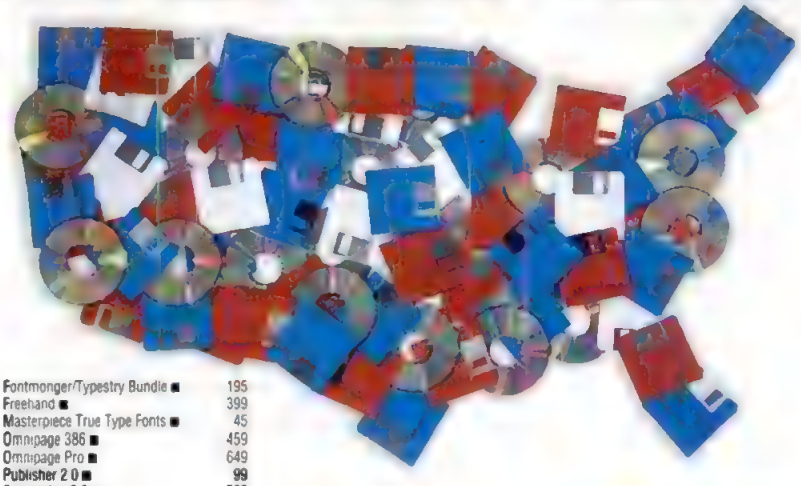

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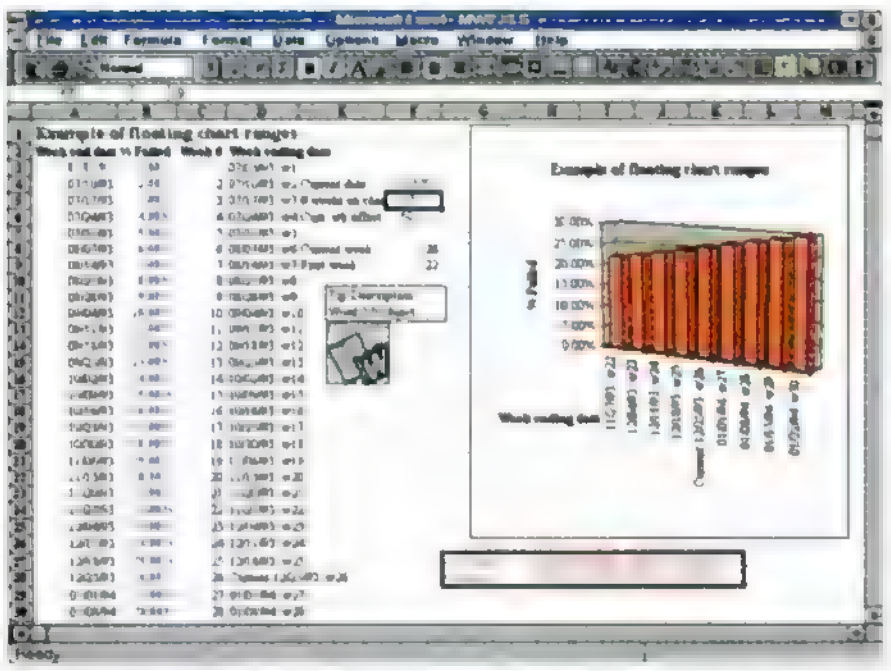

Figure 1: **This trend chart illustrates the result of using Excel's OFFSET() function, which allows the location and size of a range to depend on variables in your spreadsheet.**

Spreadsheets

PLOTTING TRENDS IN EXCEL

TIP I often have to create trend charts in Microsoft Excel 4.0 that track a few basic statistics over a period of time. Typically, only the most recent data points representing the last few weeks or months need to be displayed.

The customary way to do this in Excel is to add the latest data to the worksheet and then go to the chart and change the data series and *x*-axis label-range references so that the appropriate ranges are graphed. You select a point on the chart and edit the ranges by using the Edit Series command in its dialog box. This is a tedious and error-prone task, especially if you have multiple charts, each with multiple data series.

A better way is to base the series ranges on formulas that depend on a variable you enter into your spreadsheet. In the example shown in Figure 1, the ranges are based on a date, the usual basis for one axis in a trend chart. The date can be selected manually, it can be today's date, or it can be a week-ending date.

In Figure 1, "% failed" is to be tracked weekly. The data points in this column can, of course, be any appropriate series of values. The "Week end date" values in column A are consecutive Saturdays. The "Week #" column numbers each week in a series, week one being the week ending July 3, 1993. Column D, the "Week ending date," is the range that is plotted on the *x*-axis of the chart; this range is calculated from the "Week end date" and the "Week #" columns.

Excel's OFFSET() is the key function that makes the chart plot a different range of values each week. OFFSET() allows the location and size of a range to depend on variables in your spreadsheet. Although you cannot enter functions in the Edit Series dialog box (nor can you enter functions directly into the SERIES() formula), you can enter range names. Thus, I simply use the Define Name command to create two ranges in the spreadsheet: s1_values for the *y*-axis values (column B) and x_labels for the *x*-axis labels (column D).

The OFFSET() syntax is

```
=OFFSET(reference,rows,cols,
height,width)
```

This returns a range whose dimensions are given by height and width and whose location is determined by reference, rows, and columns. The reference argument specifies a base location; the rows and cols arguments specify the vertical and horizontal distance for the beginning of the range in relation to the base location. Thus, for example, the formula

```
=OFFSET(A1,2,3,4,5)
```

would return D3:D6, a four-row by five-column range located two rows below and three columns to the right of A1. You can use this formula in any context in which a range reference is expected. For example,

```
=SUM(OFFSET(A1,2,3,4,5))
```

would return the sum of the values stored in D3:D6.

By assigning a name to the OFFSET() expression and then supplying that name to the SERIES() formula, you can make the contents of your graph vary as one or more of the OFFSET() expression's arguments varies. In Figure 1, the names s1_values and x_labels are assigned to OFFSET() expressions in which the reference, rows, and height arguments are variables. By changing any of these variables on the worksheet, you can make the graph show a different set of data points.

Matt Woodling
Minneapolis, Minnesota

▶PC MAGAZINE: In their *Microsoft Excel Macros Step by Step* (Microsoft Press, 1992), Steve Wexler and Julianne Sharer aptly describe OFFSET() as "the function of the gods." Not only does it have innumerable uses for macro programmers, but it's also an invaluable tool for creating dynamic graphs and calculations.

The reference argument in Mr. Woodling's named expressions is a single cell—B3 for the name s1_values and D3 for the name x_labels. You can also use a range as your reference argument; if you do this, Excel calculates the offset from the upper-left cell of the range.

Suppose, for example, that you want a chart to plot the last 100 cells in a one-column range named Prices that expands from the bottom over time. You would do this by assigning a name to the following OFFSET() expression:

```
=OFFSET(Prices,ROWS(Prices)
-100,0,100,1)
```

In calculating the offset, Excel would begin at the top cell of the Prices column. From this cell it would move downward a distance of 100 rows less than the number of rows in Prices. From this point it would create a 100-row by 1-column range. To plot these points, you'd then simply feed the name of the expression to Excel's SERIES() formula.

Note that the rows and cols arguments for OFFSET() may be positive, negative, or 0. If, for example, you wanted the last 100 cells in a column whose bottom cell is named Lastcell, you could write

```
=OFFSET(Lastcell,-99,0,100,1)
```

Starting at Lastcell, Excel would move up 99 rows in the same column and select a 100-row by 1-column range beginning at this location. Mr. Woodling's tip will certainly make placing charts easier than following the conventional Excel procedure.—*Craig Stinson*

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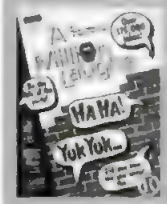

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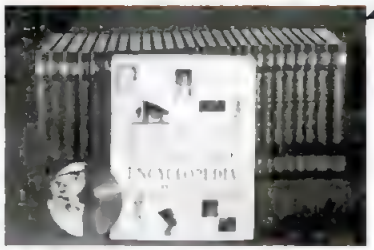

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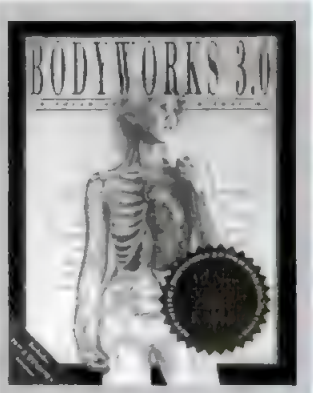

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CREATING TAB-DELIMITED FILES IN FOXPRO

TIP In the Solutions column of April 27, 1993, you published several techniques for creating a tab-delimited file in FoxPro. Another alternative is to use the text-merge facility introduced in FoxPro, Version 2.0. For example, consider the following code:

```
SET text merge ON
SET text merge TO OUTPUT.TXT
USE filename
SCAN
  \<<Field1>>
  \\<<CHR(9)>>
  \\<<Field2>>
  \\<<CHR(9)>>
  \\<<Field3>>
ENDSCAN
SET text merge TO
SET text merge OFF
FLUSH
USE
```

This code uses the text-merge facility to duplicate the results obtained by the techniques explained in your earlier column.

Ernesto G. Corrales
Buenos Aires, Argentina

▶PC MAGAZINE: Several techniques for creating custom tab-delimited data files were presented in our April 27, 1993 issue. For example, you could use the SET PRINTER TO, SET PRINT ON and ??? commands in combination. Alternatively, you could employ such low-level file functions as FCREATE(), FWRITE(), and FCLOSE(). Both of these techniques have the advantage of working with earlier releases of FoxPro and of being somewhat portable to other Xbase dialects. Starting with FoxPro 2.*x*, you can also use the text-merge facility suggested by Mr. Corrales; indeed, it seems the simplest way to go if you're using Version 2.0 or later.

The text-merge facility is designed to let you combine text with the contents of database fields, memory variables, array elements, and the results of functions, expressions, and calculations. For example, you can use it to generate a form letter that takes names and addresses from the contents of database fields and uses functions such as DATE() to print a date at the top of the letter. The text you generate doesn't have to be printed; it could be stored in a memo field or output to a defined window, for example. Still another use for the text-merge facility is to generate source code programs for your own purposes. FoxPro's own generator programs, such as GENSCRN and GENMENU, make extensive use of the text-merge facilities to produce source code for your screen and menu designs.

If you've used any of the template languages provided by other vendors for generating source code, you already have a basic understanding of how the text-merge facility can be used. The text-merge facility *is* FoxPro's template language; its big advantage is you don't have to go through the trouble of learning a new language. Other template languages require you to master a whole new (and often weird) syntax. With FoxPro, the template language is standard FoxPro plus the few simple text-merge commands shown in Figure 2.

Basically, once you turn text merge on, FoxPro looks for expressions surrounded by the text merge delimiters (by default, << and >>). When such expressions are found, FoxPro expands them in response to the commands shown in Figure 2.

Let's review the text-merge commands by using Mr. Corrales's example. The first command, SET text merge, is multipurpose; it is used both to enable or disable the text-merge facility and to specify where FoxPro should send the merged text. In the example, the text-merge facility is enabled by using

```
SET text merge ON
```

FoxPro is then told to send the merged output to a file named OUTPUT.TXT, using the command

```
SET text merge TO OUTPUT.TXT
```

(As an aside, since both the ON and TO OUTPUT.TXT are clauses of the *same* command, they can be combined into the single line

```
SET text merge ON TO OUTPUT.TXT
```

if you like to be concise).

Next in the example, the table whose contents are being merged is opened, and a SCAN...ENDSCAN loop is entered. You'll recall from the FoxPro manual that the SCAN...ENDSCAN loop makes one pass through the loop for every row in the table.

The \ and \\ commands in the loop are used to output the individual lines of merged text. When FoxPro processes these commands, it expands any expressions enclosed within the text merge delimiters, merges the results with the text, and sends the whole thing to the output destination. The default output destination is the main FoxPro window in FoxPro for Windows and the desktop in FoxPro for DOS.

Both \ and \\ can be used to merge text with the contents of tables, memory variables, array elements, and results of func-

FoxPro Text-Merge Commands

Commands	Description
\	Output line preceded by CR/LF.
\\	Output line without CR/LF.
TEXT. . .ENDTEXT	Output a block of text lines.
SET text merge ON/OFF	Enable or disable text merge.
SET text merge TO <filename>	Send merged output to the named file.
SET text merge WINDOW <window>	Send merged output to defined window.
SET text merge SHOW/NOSHOW	Show or don't show merged text in the main FoxPro window or the defined window.
SET text merge DELIMITERS TO	Alter the text merge delimiters to '(', ')', for example.

Figure 2: **FoxPro's text-merge facility is designed to let you combine text with the contents of database fields, memory variables, array elements, and the results of functions, expressions and calculations.**

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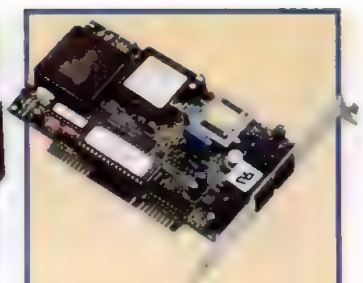

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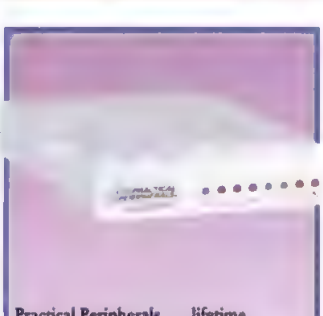

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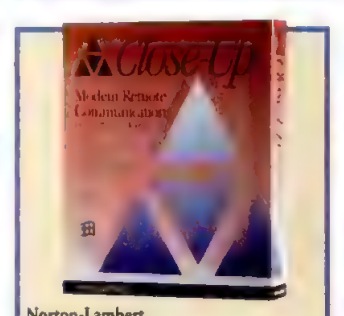

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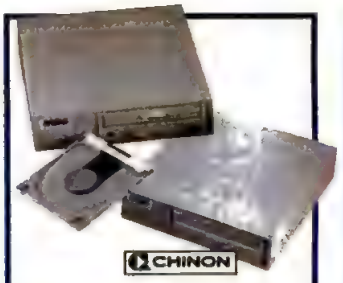

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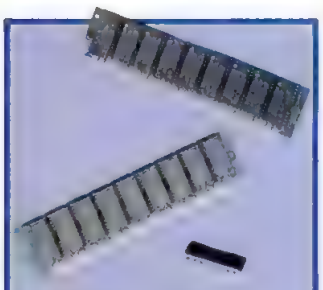

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December 7, 1993
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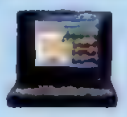

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486SX	25 MHz	212 MB/13 ms	3	2/1	512K	6.1	*6381F50*	Call	$1349
486DX	33 MHz	120 MB/15 ms	3	2/1	512K	6.1	*6381M30*	Call	$1579
PS/ValuePoint SpaceSaver (Includes 32-Bit VLB Slot, ZIFF socket, and is Pentium™ Overdrive Upgradeable)									
486SX	25 MHz	245 MB/15 ms	3	2/1	1 MB	5.2	*6382F50*	Call	$1559
486DX	33 MHz	245 MB/15 ms	3	2/1	1 MB	5.2	*6382M50*	Call	$1899
PS/ValuePoint Desktop (Includes 32-Bit VLB Slot, ZIFF socket, and is Pentium™ Overdrive Upgradeable)									
486SX	33 MHz	245 MB/15 ms	5	3/2	1 MB	5.2	*6384K50*	Call	$1759
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486DX	33 MHz	120 MB/15 ms	5	3/2	1 MB	5.2	*6384M30*	Call	$1799
486DX	33 MHz	245 MB/14 ms	5	3/2	1 MB	5.2	*6384M52*	Call	$1959
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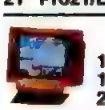

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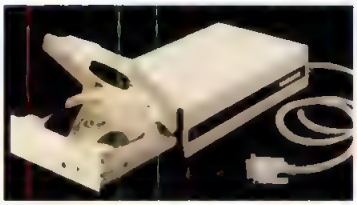

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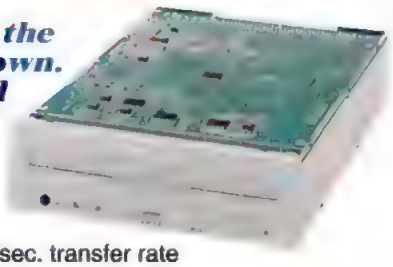

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tions and expressions. As an alternative to the backslashes, you can put a block of individual lines between TEXT and ENDTEXT commands. Within these commands, each field, memory variable, array element, function, or expression that is surrounded by text-merge delimiters will be evaluated and merged with the text. Thus, the command

```
\<<Field1>>
```

outputs a carriage return/line-feed pair followed by the contents of Field1.

The difference between the \ and \\ commands is that the former precedes its output with a carriage return/line-feed pair while the latter does not. For example, the command

```
\\<<CHR(9)>>
```

outputs only a single tab character. Note that if the SET text merge setting is turned off, both commands output literal text. That is, instead of outputting the tab character, the output would contain the literal text <<CHR(9)>>. The backslashes are ignored when outputting literal text.

Thus, using the text-merge commands, Mr. Corrales outputs a carriage return/line-feed pair, followed by the contents of Field1, followed by a tab, followed by the contents of Field2, followed by a tab, followed by the contents of Field3. The same procedure is executed for every row in the table.

You can send the merged output to a defined window by specifying the name of the window:

```
SET text merge WINDOW <window>
```

Note that when you send text-merge output to a file, it is also echoed (by default) to the main FoxPro window or the desktop. You can disable the screen display by adding NOSHOW to your SET text merge command, as in

```
SET text merge TO OUTPUT.TXT
 NOSHOW
```

When you've finished merging text, you should turn off text merge and restore the default output destination using SET text merge TO and SET text merge OFF, as shown in Mr. Corrales's example.
—*Sal Ricciardi*

Graphics

SAMPLE TYPE PAGES

❓ I've become addicted to fonts and now have hundreds of TrueType and Type1 fonts installed on my computer. I'd like to create a reference book that illustrates of all these typefaces. Are there any programs that will let me generate professional-looking type-sample pages automatically?

Dennis Carlyle
Dublin, New Hampshire

▶**PC MAGAZINE:** There are two wonderful Windows-based shareware programs that can easily generate the type specimen pages you need: FontBook, Version 2.0, and Printer's Apprentice, Version 5.61. Both of these programs allow you to view character sets on screen and to print out sample type pages using preformatted designs. Best of all, both offer a batch mode to automate the printing process.

FontBook presents you with a simple dialog box where you can add or delete fonts from a list, which in turn is used for batch printing. FontBook offers six different sample pages. My favorite is the Type Gauge page (see Figure 3) that mimics a Haberule by printing the word Typesetting (or as much of the word that will fit on the page) in sizes ranging from 5 to 72 points. FontBook is available from Sandpiper Systems, Aarron Davies, P.O. Box 82, West Ryde NSW 2114, Australia. The registration fee is $10 for home users and $20 for businesses.

Printer's Apprentice has certainly gotten a lot of press lately—much of it right here in *PC Magazine*. This is an inexpensive shareware product ($25 if you want the manual, $20 if you don't), which is distinguished by an elegant and information-laden interface. For example, you can open a window to view every kerning pair built into a font. Printer's Apprentice offers seven different specimen page layouts. I was very impressed with the program's ability to print a schematic of the keyboard, with each character in a font mapped to the correct key—an especially useful feature for dingbat alphabets. As you can see in Figure 3, the program also lists the extended character set at the bottom of the page. Printer's Apprentice is available from Lose Your Mind Development, Bryan T. Kinkel, 506 Wilder Square, Norristown, PA 19401-2643.

The easiest way to acquire either (or both) of these programs is to download them from CompuServe's DTP Forum (Go DTP, then search Library 6).
—*Luisa Simone*

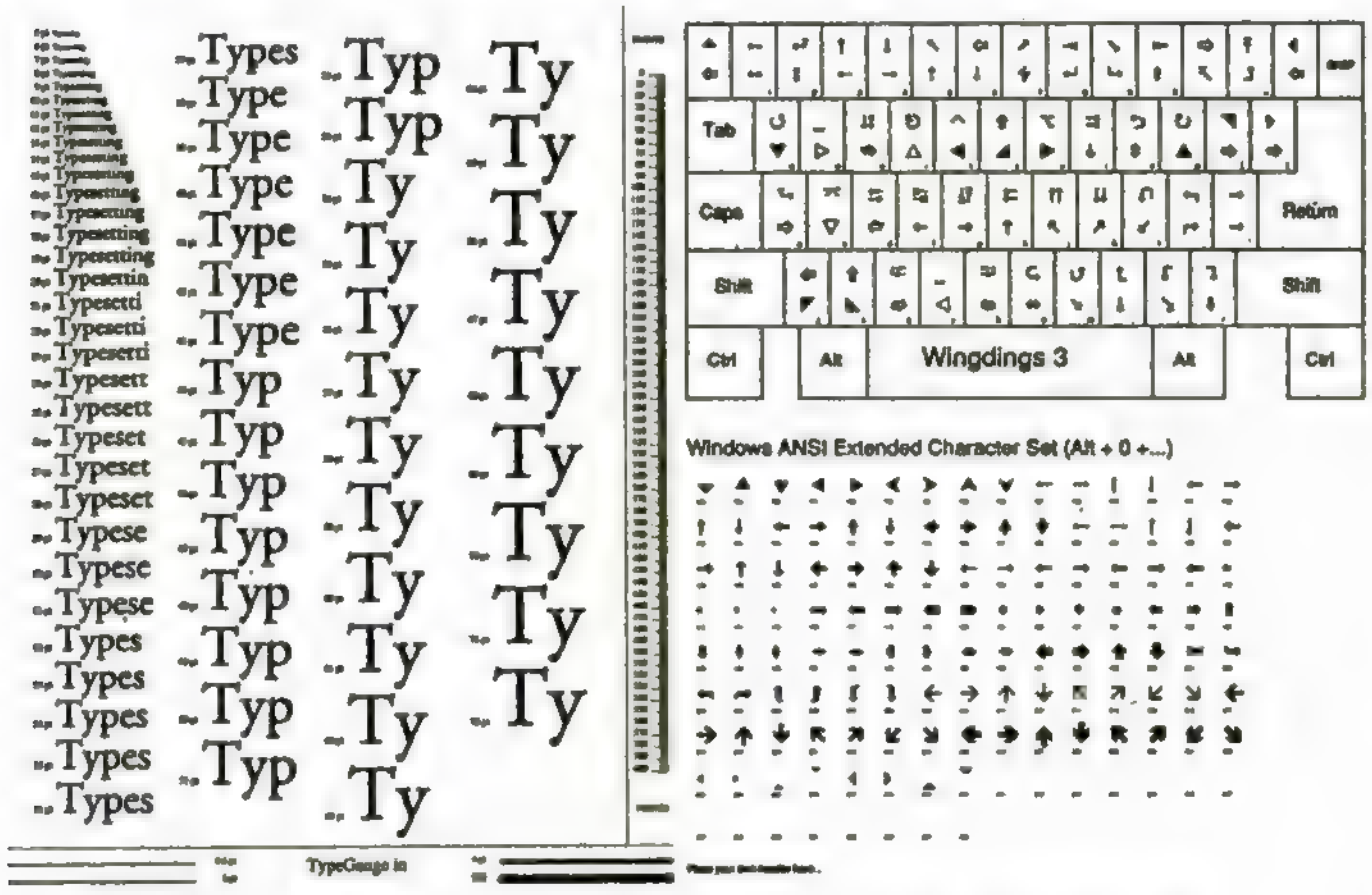

Figure 3: **Type-specimen pages produced using FontBook (left) and Printer's Apprentice (right).**

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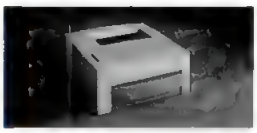

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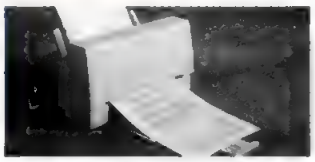

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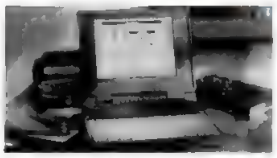

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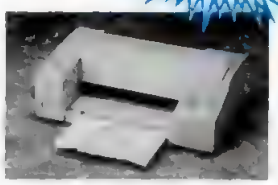

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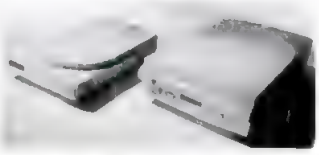

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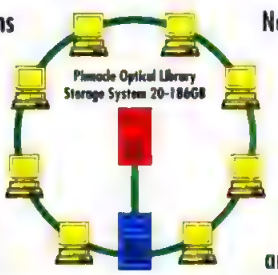

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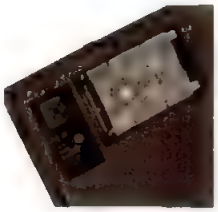

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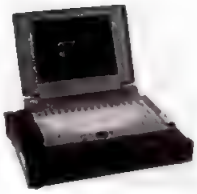

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Panther PO-12S	1.0GB	13ms		1,049.
MTX 1240S	1.24GB	8.5ms		1,399.

Seagate

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ST 41651 N	1.4GB	14.5ms	5.25"	1,199
ST 42100 N	1.4GB	14.5ms	5.25"	1,549
ST 42400 N	1.4GB	14.5ms	5.25"	1,859.
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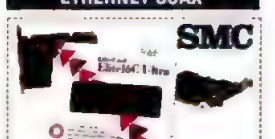

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T1950CS	i486DX2/40	4/20	9.5" Dynamic STN Color	1) Type III	6.9	1	120MB	$2479.00	31930
							200MB	$2799.00	31932
T1950CT	i486DX2/40	4/20	8.4" Active matrix Color	1) Type III	6.9	1	120MB	$2799.00	32042
							200MB	$2999.00	30243
T4600	i486SL/33	4/20	9.5" 64 Gray Scale LCD	1)IV or 2)II	6.5	SPECIAL	120MB	$3199.00	32044
							200MB	$2189.00	29539
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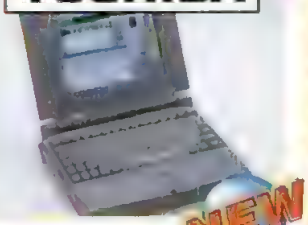

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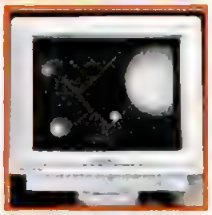

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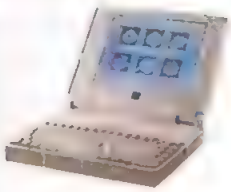

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Screen	Hard drive	Price
Monochrome	170MB	$1629*
Dual Scan Color	200MB	$2299

Lease for $59.78 /mo.

$1629*

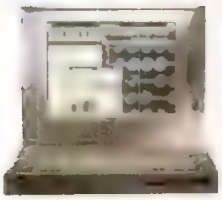
Bravo Notebook

- 486SX/25 processor
- Accelerated local bus graphics
- PCMCIA Type III slot
- MS-DOS 6.0, Windows 3.1

Screen	Model	Hard drive	Price
Monochrome	123W	120MB	$1729*
Monochrome	123W	170MB	$1799
Dual scan color	123W	120MB	$2279
Dual scan color	173W	170MB	$2449
Active matrix	173W	170MB	$3169

Lease for $63.45/mo.

$1729*



LTE Lite 4/25

- 486SL processor
- 4MB RAM expandable to 20MB
- Trackball, MS-DOS, Windows 3.1
- 3-year warranty

Display	Hard drive	Price
Monochrome	120MB	$1999*
Monochrome	209MB	$2199

Lease for $73.36/mo.

$1999*

Contura

- 486SL/25 processor
- 4MB RAM
- Trackball, MS-DOS, Windows
- 3-year warranty

Display	Hard drive	Price
Monochrome	209MB	$2199*
Dual scan color	209MB	$2879
Active matrix	209MB	$3479

Lease for $80.70/mo.

$2199*

PowerExec 4/25SL

- 4MB RAM expandable to 32MB
- 9.5" display
- 2 Type II PCMCIA slots
- 200MB hard drive
- SmartPoint trackball
- MS-DOS 6.0, Windows 3.1

Model	Screen	Price
4/25SL 203/W	Mono	$2399*
4/25SL 203/W	Active Matrix	$4029

Lease for $88.04/mo.

$2399*

PowerExec 4/33SL

- 4MB RAM expandable to 32MB
- 9.5" display
- 1 Type III or 2 Type II PCMCIA slots
- 200MB or 340MB hard drive
- SmartPoint trackball
- MS-DOS 6.0, Windows 3.1

Model	Screen	Hard Drive	Price
4/33SL 203/W	Mono	200MB	$2629*
4/33SL 203/W	Active	200MB	$4229
4/33SL 343/W	Active	340MB	$4629

Lease for $96.48/mo.

$2629*

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CIRCLE 238 ON READER SERVICE CARD

Texas Instruments

TravelMate: The Industry's Lone Star

4000E WinSX/25

- ▲ 486SX/25 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 10" monochrome display
- ▲ 120MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for $68.59/mo.

$1869*

4000E WinSX/25 Color

- ▲ 486SX/25 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 8.2" enhanced color display
- ▲ 120MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard'
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for $77.03/mo.

$2099*

4000E WinDX2/50

- ▲ 486DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 10" monochrome display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for 99.05/mo.

$2699*

4000E WinDX2/40 Color

- ▲ 486DX2/40 processor
- ▲ 4MB RAM expandable to 20M
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for $99.05/mo.

$2699*

4000 WinDX2/50 Dual Scan Color

- ▲ 486DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 9.4" dual scan color display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for $108.20/mo.

$3289*

4000E WinDX2/50 Active Matrix

- ▲ 486DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 8.4" active matrix color display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for $124.98

$3799

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TravelMate Intelligent Docking System

- ▲ Instantly transforms your TravelMate notebook into a full-sized, full-featured 486 desktop PC
- ▲ 6 16-bit expansion slots
- ▲ 2 PCMCIA Type III slots
- ▲ 4 internal drive bays- EPP parallel, 2 serial, VGA, mouse,keyboard, RJ-11 jack and game ports
- ▲ Designed for all TravelMates with QuickPort connectors

$799.99

TEXAS INSTRUMENTS

PC MAGAZINE EDITORS' CHOICE — WinDX2/50 August 1993

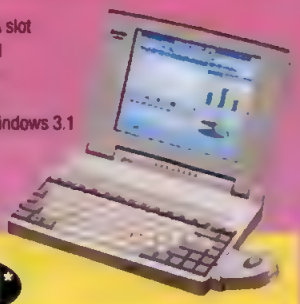
PC MAGAZINE EDITORS' CHOICE — WinSX/25 August 1993

PC MAGAZINE EDITORS' CHOICE — WinSX/25 Color August 1993

Toshiba Direct

T1900/T1950

- 4MB RAM, expandable to 20MB
- 9.5" display
- Type III PCMCIA slot
- 82-key keyboard
- Ballpoint mouse with QuickPort
- MS-DOS 6.0, Windows 3.1



$1729*

Model	Screen	Hard drive	Price
T1900 486SX/20	Monochrome	200MB	$1729*
T1900 486SX/20	Dual scan color	120MB	$2099
T1900 486SX/20	Dual scan color	200MB	$2329
T1950 486DX2/40	Monochrome	120MB	$1899
T1950 486DX2/40	Monochrome	200MB	$2099
T1950 486DX2/40	Dual scan color	120MB	$2499
T1950 486DX2/40	Dual scan color	200MB	$2719
T1950 486DX2/40	Active color	120MB	$2649
T1950 486DX2/40	Active color	200MB	$3069
T1950 486DX2/40	Active color	320MB	$3399

Lease for $55.01/mo.

T4600

- 33MHz 486SL processor
- 4MB RAM, expandable to 20MB
- 9.5" display
- 2 PCMCIA slots (1 Type II, 1 Type III)
- Ballpoint mouse with QuickPort
- MS-DOS 6.0, Windows 3.1

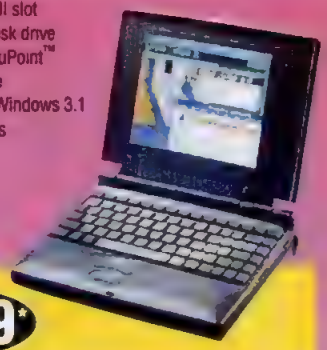
$2249*

Screen	Hard drive	Price
Monochrome	120MB	$2249*
Monochrome	200MB	$2297
Active matrix color	120MB	$3089
Active matrix color	200MB	$4099
Active matrix color	320MB	$4449

Lease for $82.53/mo.

Portégé T3400

- Ultra-portability at only 4.1 lbs. (4.4 lbs. for color)
- 486SX/33 processor
- 120MB hard drive
- 4MB RAM, expandable to 20MB
- PCMCIA Type II slot
- External 3.5" disk drive
- Integrated AccuPoint™ pointing device
- MS-DOS 6.0, Windows 3.1 & CommWorks



$2259*

Screen	Price
Monochrome	$2259*
Active color	$3469

Lease for $82.91/mo.*

TOSHIBA

T4700

- 486DX2/50 processor
- 8MB RAM, expandable to 24MB
- Brilliant 9.5" display with local bus video
- 2 PCMCIA slots (1 Type II, 1 Type III)
- Microsoft Sound System, built-in microphone, audio out port
- MS-DOS, Windows 3.1, UltraFont & Indeo video compression software

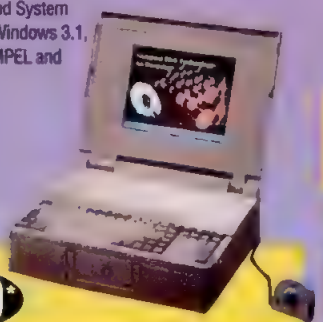
$3999*

Screen	Hard drive	Price
Dual scan color	200MB	$3999*
Dual scan color	320MB	$4329
Active matrix color	200MB	$4599
Active matrix color	320MB	$4949

Lease for $131.57/mo.

T6600

- 486DX2/66 processor
- 8MB RAM, expandable to 40MB
- 510MB hard drive
- 10.4" active color display
- 16mm PCMCIA slots
- 2 full-length 16-bit ISA slots
- Detachable 101-key keyboard
- 2 built-in stereo speakers
- Microsoft Sound System
- MS-DOS 6.0, Windows 3.1, Asymetrix COMPEL and MediaBlitz



$6289*

Model	Description	Price
T6600C	Base model	$6289*
T6600C/CD	Base model+Toshiba 2X CD-ROM drive	$6799
T6600C/CDV	Base model+CD-ROM +Mambo DVI board	$7859

Lease for $206.91/mo.*

Desk Station IV

Toshiba's Desk Station IV turns your T4400, T4500, T4600, and T4700 into a full-function desktop computer by providing:

- 2 full-size, 16-bit industry standard expansion slots
- 5.25" half-height drive bay
- Parallel, serial, PS/2 mouse, VGA monitor, 101-key keyboard ports and 1 floppy disk drive port
- Separate monitor stand
- Notebook, monitor, and keyboard extra

$599.99

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CIRCLE 092 ON READER SERVICE CARD

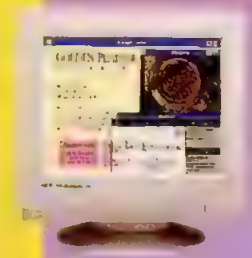
NEC: Ready and VERSAtile...

NEC Technologies, Inc. is a leading manufacturer of computers and peripherals for the North American market. Ready and Versatile, NEC desktops, multimedia desktops, and notebooks offer a host of options. The NEC product line includes the new UltraLite Versa E series of notebooks, Ready line of desktops, award-winning MultiSync monitors, Silentwriter laser printers, and the new triple-speed MultiSpin CD-ROM drives.

UltraLite Versa E

For ease of upgrade, the Versa E's floppy drive, hard disk drive and memory card slide in and out of their storage slots. For example increase your hard disk storage from 120MB to 250MB by just sliding the components in and out. If you require extended battery life, slide out the Versa's floppy drive, pop in a second battery, and double your time on the road. Also the Versa E incorporates two Type II PCMCIA slots to add industry standard communications options such as a modem or cellular and local area network products. And, in response to customer requests, the new Versa E series features the front-mounted VersaTrack integrated trackball, a smaller AC adapter, lightning fast Accelerated Local Bus video and a brighter color screen.

NEC



MultiSync Monitors

View the latest in the line of award-winning monitors, which include a 3-year warranty!

3V
- ▲ 15" SVGA
- ▲ 1024x768, .28mm ni
- ▲ 72MHz VESA refresh rate
- ▲ MPR II, EnergyStar compliant
- ▲ Great for Entry-level business/ Windows applications

$519.99

5FGp
- ▲ 17" SVGA
- ▲ 1280x1024, .28mm ni
- ▲ Opticlear surface
- ▲ Intelligent Power Management System (IPM)
- ▲ Great for entry-level CAD, color desktop publishing

$1359.99

6FGp
- ▲ 21" SVGA
- ▲ 1280x1024, .28mm ni
- ▲ Opticlear surface
- ▲ Intelligent Power Management System (IPM)
- ▲ Great for professional CAD/CAM/CAE, graphic design, color desktop publishing

$2369.99

NEC MultiSpin 3X CD-ROM Drives

New from NEC— the fastest CD-ROM Drives available
- ▲ Triple speed 450Kb/sec transfer rate, 195ms access time & 256K buffer
- ▲ MPC Level 2 compliant, Multisession Photo CD & XA-compliant
- ▲ Sleek new design features front panel LCD controls for display of data, audio & diagnostics data
- ▲ Full audio control buttons (play, repeat, track advance, pause, stop) on front panel for your music CDs. And play audio CDs without a PC.

MultiSpin 3Xp Portable Drive	**$429.99**
MultiSpin 3Xi Internal Drive	**$479.99**
MultiSpin 3Xe External Drive	**$569.99**

UltraLite Versa E
- ▲ 486 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball

Processor	Screen	Hard drive	Price
DX2/40	Monochrome	120MB	$2579*
DX2/40	Monochrome	250MB	$2989
DX2/40	Active color	120MB	$3819
DX2/40	Active color	250MB	$4229
DX2/50	Monochrome	209MB	$3259
DX2/50	Monochrome	340MB	$3669
DX2/50	Active color	209MB	$4499
DX2/50	Active color	340MB	$4919

Lease for $94.65/mo.

$2579*

Ready Desktops
- ▲ 4MB RAM, expandable to 36MB
- ▲ 3.5" floppy drive
- ▲ 9600/4800 fax, 2400 data modem*
- ▲ Local bus graphics
- ▲ MS-DOS 6.0, Windows 3.1, PFS: Window Works, America-On-Line, CompuServe

Processor	Hard drive	Price
486SX/25*	170MB	$999*
486SX/33	210MB	$1249
486DX2/66	250MB	$1739

**486SX/25 does not include modem*

NEC SVGA color monitor $319.99

Lease for $50/mo.

$999*

Ready Mutimedia Desktops
- ▲ *Includes features of standard desktops plus.*
- ▲ Fast double or triple speed CD-ROM drives
- ▲ MediaVision 16-bit stereo sound
- ▲ Labtec speakers, headphone, and microphone
- ▲ MS-DOS 6.0, Windows 3.1, America-On-Line, CompuServe
- ▲ CD-ROM titles include: PFS: Window Works, Compton's Encyclopedia, Dinosaur Adventure and Space Adventure

Processor	Hard drive	Price
486SX/25	170MB	$1499*
486SX/33	250MB	$1899

Lease for $55.01/mo.

$1499*

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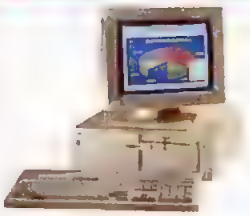

LEADING EDGE

WinPro 486e VL

- 486 processor
- 4MB RAM expandable to 32MB
- VESA local bus graphics
- 3.5" and 5.25" floppy drives
- MS-DOS 6.0, Windows 3.1, Works

Processor	Hard drive	Price
486SX/25	170MB	$969*
486SX/33	170MB	$1059
486DX/33	260MB	$1259
486DX2/66	345MB	$1789

Color VGA monitors start at $229.99

Lease for $50/mo.

$969*

AST

Bravo Desktops

- 4MB RAM expandable to 64MB
- 120MB or 210MB hard drive
- Local bus graphics 1024x768
- Pentium OverDrive upgradable

Model	123/W	213/W	Price
4/25s	120MB	—	$999*
4/33	120MB	—	$1299
4/33	—	210MB	$1539
4/66d	—	210MB	$2099

AST SVGA color monitor $379.99

Lease for $50/mo.

$999*

COMPAQ

ProLinea Desktops

- 4MB RAM expandable to 32MB
- 3.5" floppy drive
- Local bus graphics
- MS-DOS 6.0, Windows 3.1, Mouse

Model	Hard drive	Price
486SX/33	120MB	$1109*
486SX/33	240MB	$1259
486DX/33	120MB	$1389
486DX/33	240MB	$1469
486DX2/66	340MB	$1979

Compaq SVGA color monitor $349.99

Lease for $50/mo.

$1109*

AST

Bravo MT MiniTower

- 4/8MB RAM expandable to 64MB
- 170MB or 340MB hard drive
- EPA Energy Star certified
- 32-bit accelerated local bus
- MS-DOS 6.0, Windows 3.1

Model	RAM	Hard drive	Price
4/33 173W	4MB	170MB	$1539*
4/33 343W	8MB	340MB	$1999
4/66d 173W	4MB	170MB	$2099
4/66d 343W	8MB	340MB	$2539

AST SVGA color monitor $379.99

Lease for $56.48/mo.

$1539*

Cygnet

Power Series

- 486DX2/66, Pentium ready
- 450MB hard drive
- VESA local bus, 1MB exp. to 2MB
- Double-speed CD-ROM

RAM	Video Speed	Price
8MB	20M Winmarks	$2149*
16MB	20M Winmarks	$2479
16MB	60M Winmarks	$2699

15" SVGA color monitor $399.99

ESIA and Tower models available

Lease for $78.87/mo.

$2149*

COMPAQ

DESKPRO/M

- 4 32-bit EISA expansion
- Intelligent modularity
- QVision graphics controller
- MS-DOS 6.0, Windows 3.1, mouse

Processor	RAM	Hard drive	Price
486DX/33	8MB	240MB	$2659*
486DX/33	8MB	340MB	$3069
486DX2/66	8MB	510MB	$3739

COMPAQ SVGA color monitor $349.99

Lease for $97.58/mo.

$2659*

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Norton Desktop for Windows 3.0	$79.99*
Norton pcAnywhere	$89.99*
WinFax Pro	$59.99*
LapLink V	$69.99*

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TI microMarc™ Inkjet Printer

$279

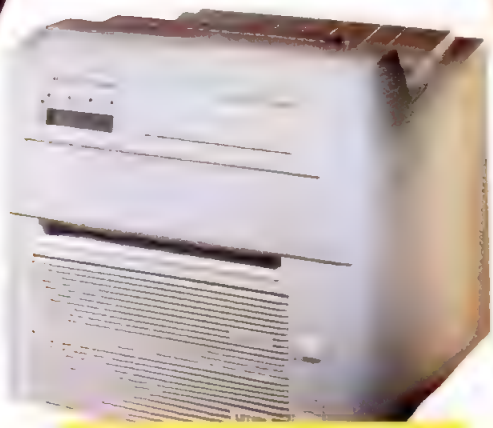
TEX1Ø23

TI microWriter™ PS23 Printer

PC MAGAZINE EDITORS' CHOICE

$679

TEX1Ø21



TI microLaser™ Pro 600 PS23 Laser Printer

PC MAGAZINE EDITORS' CHOICE

$1,349

TEX1Ø24

TI microMarc™ Inkjet

For about the same price as a dot matrix printer, the new TI microMarc gives you the same 300 dpi print resolution as most laser printers. And with its advanced inkjet technology, print quality stays constant for the life of the print cartridge, instead of fading like a dot matrix ribbon. The microMarc is so quiet, reliable, inexpensive to run and easy to use, it can help you do more with your printer than you ever thought possible.

- Unsurpassed ease of use.
- Very affordable price.
- Professional quality printing for your Windows/DOS applications.
- Reliable Performance.
- Fast Print Speed.
- Versatile fonts, flexible paper handling.
- Whisper-quiet operation.

TI microMarc Inkjet printer
300 cps, 300 dpi, 1,400 pages per cartridge, 24K memory TEX1Ø23 .....$279

Don't forget to add an extra print cartridge. Keep a spare to insure uninterrupted productivity. TI microMarc Print Cartridge TEX7Ø23.....$39

TI microLaser™ Pro 600 Lasers

TI microLaser Pro 600 PS23
Razor-sharp 600 dpi, 6MB memory, fast 8ppm print speed with RISC processor, built-in PostScript Level 2 software and PCL5, DOS/Mac compatible, 15,000 copy toner cartridges, 250-sheet paper trays, 8 HPLJIII fonts and 23 PostScript fonts. TEX1Ø24.....$1,349

TI microLaser Pro 600 PS65
All of the features of the TI microLaser Pro 600 PS23, plus 42 additional PostScript fonts. TEX1Ø26...$1,529

TI microWriter™ PS23

For years, capability and affordability were mutually exclusive features of laser-quality printers. But the new microWriter PS23 from Texas Instruments has changed all that. Now you can get sharp, crisp laser-quality images, rapid 5 page-per-minute operation and the reliability of LED technology. All in one very affordable printer. Thus enabling you to print more. Produce more. Do more. In other words, to extend your reach. The new TI microWriter PS23 and TI microWriter PS65. They can make a small business look a lot bigger. And a big business look a lot smarter.

- Laser quality, high resolution (300dpi) printing.
- Reliable LED Technology.
- Fast 5 ppm print speed.
- Grows with your needs.
- Small footprint for true desktop use.

TI microWriter Basic
5ppm, 14 HP LJ II fonts, Postscript upgradable option, 512K memory. TEX1Ø19.....$499

TI microWriter PS23
5ppm, 14 HP LJ II fonts, Postscript, DOS/Mac compatible, 2MB memory and 23 standard PostScript fonts. TEX1Ø21.....$679

TI microWriter PS65
5ppm, 14 HP LJ II fonts, Postscript, DOS/Mac compatible, 2MB memory and 65 standard PostScript fonts. TEX1Ø22 .....$929

The Texas Instruments 30-Day Satisfaction Guarantee

When you buy any TI printer, your satisfaction is guaranteed.

Insight

800-546-0586

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$2,049
TEXTMS25CE

Lease as low as $105/Mo

- 486SX 25MHz CPU
- 640 x 480 VGA 8.2" Color Display
- 256 Colors Simultaneously
- Pre-installed Windows 3.1™ and MS DOS®
- 4MB RAM, expandable to 20MB
- 120MB Hard Disk Drive
- MS BallPoint® with QuickPort™ Connection

TravelMate 4000E WinDX2™/50 Dual Scan COLOR

$3,219
TEXTMD25ØD

Lease as low as $149/Mo.

- 486DX2 50MHz CPU
- Dual Scan Color Display
- Pre-installed Windows 3.1™ and MS DOS®
- 4MB RAM, expandable to 20MB
- 200MB Hard Disk Drive
- MS Ball Point® with QuickPort™ Connection

TravelMate 4000E WinDX2™/50 COLOR

$3,699
TEXTMD25ØC

Lease as low as $169/Mo

- 486DX2 50MHz CPU
- 8.4" Active Matrix Display
- Pre-installed Windows 3.1™ and MS DOS®
- 4MB RAM, expandable to 20MB
- 200MB Hard Disk Drive
- MS Ball Point® with QuickPort™ Connection

TravelMate 4000E WinDX2™/40 COLOR

- 486DX2 40MHz CPU
- 640 x 480 VGA 9.4" Color Display
- 256 Colors Simultaneously
- Pre-installed Windows 3.1™ and MS DOS®
- 4MB RAM, expandable to 20MB
- 200MB Hard Disk Drive
- MS BallPoint® with QuickPort™ Connection

$2,679
TEXTMD24ØE

Lease as low as $130/Mo

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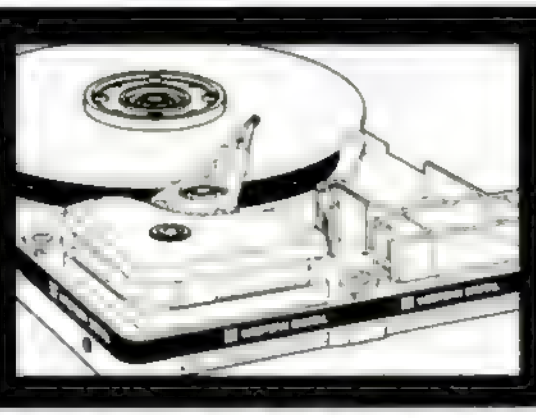

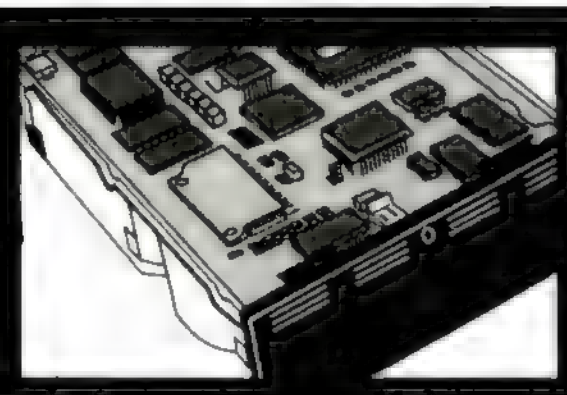

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GSI GSI drive accelerators increase the data transfer rate of your IDE drive 30 to 80%. Works by enabling the drives Read Multiple & Write Multiple commands to greatly increase performance. We highly recommend these products for Conner, Quantum, Seagate, Micropolis, Maxtor, & Fujitsu.

	Alone	w/Drive
GSI-21 Board supports 2 IDE, 4 floppy drives. Doubles QIC-80 tape drive speed	$65	$55
GSI-18 Board supports 2 IDE drives. Works in conjunction with MFM, RLL, etc.	$55	$45
GSI-32 Board same as -21 adds 2 16550 serial ports & 1 bi-directional parallel port	$139	$119
GSI MaxIDEA Software solution works on existing IDE configuration (requires less than 1K of memory). Includes performance benchmark test.	$34	$25

HARD DRIVES

CONNER

IDE			
170MB	13ms	CFA170A	$189
210MB	14ms	CFS210A	$235
340MB	13ms	CFA340A	$299
420MB	14ms	CFS420A	$339
540MB	10ms	CP30544	$569
SCSI			
1060MB	9ms	CFP1060S	$939

digital

SCSI			
1600MB	9.7ms	DSP3160	$1159
2103MB	9.7ms	DSP3210	$1559
3500MB	11ms	DSP5350	$2399
4000MB	11ms	DSP5400	$2599

FUJITSU

SCSI			
520MB	12ms	M2624F	$499
1080MB	9ms	M2694F	$829
2060MB	12ms	M2654S	$1449
IDE			
520MB	12ms	M2624T	$499

Maxtor

IDE			
245MB	15ms	7245A	$229
345MB	14ms	7345A	$288
540MB	12ms	7546A	$539
540MB	8.5ms	MXT540A	$689
SCSI			
245MB	15ms	7245S	$259
345MB	14ms	7345S	$329
540MB	8ms	MXT540S	$689

MICROPOLIS

IDE			
1050MB	10ms	MC2210A	$846
1740MB	10ms	MC2217A	$1122
SCSI			
1050MB	10ms	MC2210	$846
1750MB	10ms	MC2217	$1122
3020MB	11ms	MC1936	$2065

Differential Wide SCSI! The ultimate setup for speed. Price includes EISA card & cables! MC2210DW $1899 MC2217DW $2199 MC1936DW $3229
Also available Audio / Visual tuned drives!

WESTERN DIGITAL

IDE			
256MB	12ms	AC2250	$220
341MB	12ms	AC2340	$280
425MB	12ms	AC2420	$335
520MB	12ms	AC2540	$429

Boost WD performance 26% with MaxIDEA!

HARD DRIVES

Quantum

IDE			
170MB	14ms	LPS170A	$189
270MB	12ms	LPS270A	$259
342MB	12ms	LPS340A	$359
541MB	12ms	LPS540A	$555
SCSI			
170MB	14ms	LPS170S	$189
270MB	12ms	LPS270S	$259
342MB	12ms	LPS340S	$359
541MB	12ms	LPS540S	$585
1080MB	10ms	IMP1080	$879
1225MB	10ms	PD1225S	$969
1800MB	10ms	PD1800S	$1199

Seagate

IDE			
213MB	16ms	ST3243A	$199
260MB	16ms	ST3290A	$239
341MB	12ms	ST3390A	$319
452MB	12ms	ST3550A	$429
528MB	12ms	ST3655A	$559
SCSI			
2145MB	8ms	ST12550N	$1859

CONTROLLER CARDS

	Alone	w/Drive
ADAPTEC		
A1522Basic 16Bit SCSI	$99	$89
A1542CBasic 16Bit SCSI	$269	$249
A2742 EISA SCSI	$389	$369
A2842 VESA SCSI	$319	$299
T130 8Bit SCSI	$79	$65
T348 Parallel to SCSI	$189	$179
FUTURE DOMAIN		
850MCD 8Bit SCSI	$79	$65
1680SVP 16Bit SCSI	$155	$139

Many other types of controllers in stock.

HARD DISK CARDS

Drive & controller on card. Saves drive bay. Compatible with XT, AT, Tandy, and others.

170MB	$269	240MB	$339
340MB	$439	525MB	$779

IBM PS/1 PS/2 DRIVES

Complete solutions for your IBM. IBM recomends & buys from MegaHaus!

	170MB	240MB	340MB
PS/1 386 & 486	$239	$309	$389
PS/2 25, 30, 30-286	$299	$389	$479
PS/2 35 & 40	$229	$299	$379
PS/2 50 thru 95	$379	$459	$559

Larger capacities in stock. PS/1 286 120MB $589

MULTI-MEDIA KITS

Includes:
- Double speed CD ROM drive
- Media Vision Jazz Pro Studio add $100
- Amplified Speakers
- Toolworks CD Bundle (World & US Atlas, Groliers Encyclopedia, San Diego Zoo's The Animals Chessmaster 3000, Mavis Beacon Teaches Typing)

Toshiba	XM3401	200ms	$589
Sony	CDU 561	295ms	$559
Sony	33A	325ms	$399
Teac	CD-50	265ms	$509

ALTEC LANSING SPEAKERS CALL $

CD ROM DRIVES

NEC	3Xi	195ms	$469
Toshiba	XM3401B	200ms	$365
Sony	CDU561	295ms	$329
Teac	CD-50	265ms	$309
Toshiba	XM4101B	320ms	$269
6 Disc Changer			
Pioneer	DRM600	600ms	$839
Pioneer	DRM604X	300ms	$1199

CD SOFTWARE

CD Software not sold separately only with CD ROM Drives.

Bundle 1 San Diego Zoo's The Animals,Toolworks Reference Library, Toolworks/Groliers's Multimedia Encyclopedia , Toolworks World & US Atlas Pak, & Tempra Photo CD Access $89
Bundle 2 San Diego Zoo's The Animals, Toolworks Reference Library, World Atlas, US Atlas w/ Auto Map, Sherlock Holmes, Sports Best, Arthur's Teacher Trouble, Chessmaster 3000, & Family Choice/ Britanica Encyclopedia $159
Bundle 3 Toolworks Encyclopedia, Reference Library, World & US Atlas,Game Pack, Secret Weapons of the Luftwaffe $79
Power Tools A great shareware library $25
Family Doctor answers to 1500+ questions $66
Game Pak II 10 games incl. Chessmaster 3000 $19
The Lord of the Rings A great new game $45
Languages of the World 12 language translations $32
Mayo Clinic medical ailments reference $19
US Atlas w/ auto map intelligent road atlas $29
CIA World Tour 248 CIA country profiles $25

OPTICAL DRIVES

Kit is 16Bit Card & 1 disk		Bare	Kit
128MB	Fujitsu	$725	$879
650MB	Hewlett Packard	$1999	$2279
1.3Gig	Hewlett Packard	$2659	$2959
1.3Gig	Maxoptix	$3199	$3479
Verbatim Optical Media		1	5
128MB / 650MB		$42/$109	$38/$95

Many other brands and types in stock.

TAPE DRIVES

CONNER

250MB QIC-80 tape drives includes software & tape

	Alone	w/drive
Internal fits 3.5 or 5.25 bay	$155	$139
External for printer port	$335	$325

SCSI Tape Drives

Kit is 16Bit card & 1 tape			Bare	Kit
580MB	Teac	MT01	$529	$729
75-15Gig	Exabyte	2501	$699	$899
2Gig	Conner	4320	$799	$969
2Gig	HP	35470	$939	$1059
2-5Gig	Exabyte	8205	$1449	$1699
4-8Gig	Conner	4324	$1119	$1329
4-8Gig	HP	35480	$1079	$1299
4-16Gig	Sony	SDT5000	$1199	$1429
5-10Gig	Exabyte	8505	$2259	$2519

REMOVEABLE DRIVES

Syquest			Bare	Kit
44/88MB	20ms	SQ5110C	$259	$439

Syquest Media Best Price in this mag!

TEAC

	Alone	w/HD
Floppy 1.4 (1.2 + $9)	$45	$42
Floppy Combo 1.2 & 1.4	$124	$117

Removable Hard Disk Drive Kits
Very high quality removable drive
17ms IDE drive with docking bay
250MB $309 360MB $379

DRIVE ACCESSORIES

SCSI Drive enclosures	
3.5" vertical	$99
Half Height	$89
Full Height / Dual Half Height	$139
Dual Full Height / Four Half Height	$329
Four Full Height / Eight Half Height	$549

Removable drive brackets, turns any 3.5" hard drive into removable IDE / SCSI $69/$119

PCMCIA

Maxtor 105MB, 19ms hard drive $559
PCMCIA to SCSI adapter $319
Desktop Docking Module! Mounts in 5 1/4" drive bay. Allows you to use any PCMCIA in your desktop $249

MEMORY

	Alone	w/HD
1x3-70ns (60ns + $3)	$50	$47
1x9-70ns (60ns + $4)	$60	$56
4x9-70ns (60ns + $5)	$169	$159

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Purchasing an Elite System or Notebook from MidWest Micro is risk-free and worry-free. Elite Systems and Notebooks are fully tested and burned in before shipment. Try an Elite System or Notebook for 30 days. If it doesn't meet your needs send it back and we'll refund your money. It's that simple.

Technical Support/Customer Service—At Your Beck And Call

Our System Consultants do more than answer questions; they listen to your needs, analyze the situation and then recommend a solution. You can depend on MidWest Micro's Technical Staff to help keep your Elite up and running through even the most difficult applications.

Guaranteed To Satisfy Even The Most Demanding Pharaoh

You need a computer you can depend on—that's why Elite Systems, Notebooks and SubNotes are backed by a one year warranty. During that time we offer immediate parts replacement for components you can easily install. For internal repairs, simply send us your system or notebook and we'll correct the problem within 72 hours. Our fast-turnaround times mean you'll never be without your Elite System for long.

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With NEW business leasing options from MidWest Micro your company can get the computer systems you need—today! Our affordable payment plans are designed to meet your business' monthly budget and free up capital for other important business ventures. One more way MidWest Micro helps you control your business expenses. Don't wait months to get the systems you need—call your MidWest Micro sales representative today for more details on leasing opportunities.

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Get your system or notebook the way you want it. We can install fax modems, more RAM, a larger hard drive and all the other accessories you've been looking for. If you're configuring a system, you can even choose any one of our five new case designs. Ask your sales representative for details.

Built For A King

We've created majestic NEW cases for all our systems. Made for a king, these attractive cases have a sleek design that's both convenient and sturdy. They even offer more expansion options. Select from our slimline, desktop, mini-tower, mid-tower and full-tower cases. When you start with an Elite System, you start with a solid foundation—so adding peripherals is easy. Choose from our large selection of tape backups, modems, printers, memory upgrades, and more.

Colorado Memory Systems TBU #CTS08S $159

With high-speed data compression, this 250 Mb internal automatic tape backup unit copies up to 9.5 Mb per minute. It includes a FREE cable and easy-to-use Windows software.

It's No Secret

Did you know that when you buy a system from MidWest Micro you can add or exchange one of your floppy drives for a CD-ROM drive? It's easy. Ask your MidWest Micro representative for more details.

Cleopatra Says, "Go Green!"

In an effort to be 100 percent energy efficient, MidWest Micro participates in the EPA's Energy Star Program. Only PC's monitors and printers that power down to less than 30 watts while idle are recognized in the program. MidWest Micro is dedicated to helping the environment and helping you save money on monthly electric bills. Call your MidWest Micro sales representative to learn more about the Energy Star Program.

MidWest Micro

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- 80486SX-33 Processor
- 2 Mb High-Speed RAM
- 125 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 14" SVGA .39 Color Monitor
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- 101-Key Enhanced Keyboard
- Slimline Case
- FREE Microsoft DOS 6.2 Installed

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486DX-33 $1399
#006600

Treasures:
- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 32-Bit VESA Local Bus IDE Card
- 245 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 14" SVGA .28 Non-Interlaced Color Monitor
- 32-Bit VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- Mini-Tower Case
- FREE Microsoft DOS 6.2 Installed
- FREE Microsoft Windows Installed

486DX2-50 $1449
#006601

486DX2-66 $1559
#006602

VESA Windows Systems

486DX-33 $1529
#006607

Treasures:
- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 32-Bit VESA Local Bus IDE Card
- 245 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 15" SVGA .28 Non-Interlaced Multi-Scan Color Monitor
- Diamond Stealth 24 VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- Mid-Tower Case
- FREE Microsoft DOS 6.2 Installed
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486DX2-50 $1559
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#006609

VESA Multimedia Systems

486DX-33 $1799
#006610

Treasures:
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- Intel 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 245 Mb IDE Hard Drive
- 32-Bit VESA Local Bus IDE Card
- 1.44 Mb 3.5" Floppy Drive
- Dual Speed Multi-Session Multimedia CD-ROM Drive
- 3 Disk CD-ROM Software Library
- 16-Bit High-Performance Sound Card
- Digital-Quality, Compact Speakers
- 15" SVGA .28 Non-Interlaced Multi-Scan Color Monitor
- 32-Bit VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- Mini-Tower Case
- FREE Microsoft DOS 6.2 Installed
- FREE Microsoft Windows Installed

486DX2-50 $1849
#006611

486DX2-66 $1999
#006612

VESA CAD Systems

486DX-33 $2159
#006613

Treasures:
- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 256K High-Speed Cache
- 8 Mb High-Speed RAM
- 32-Bit VESA Local Bus IDE Card
- 340 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 17" SVGA .26 Non-Interlaced Multi-Scan Color Monitor
- Diamond Stealth 24 VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- Full-Tower Case
- FREE Microsoft DOS 6.2 Installed
- FREE Microsoft Windows Installed

486DX2-50 $2199
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486DX2-66 $2369
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PCI Local Bus System

486DX2-66 $2999
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Elite's PCI Systems have a 32-bit data path and 33 MHz clock speed to produce maximum data transfer rates of 132 megabytes per second—a monumental improvement over standard ISA buses' 5 Mb/sec transfer rate! And since they are self-configuring, you should never have to touch switches or jumpers in Elite PCI Systems.

Treasures:
- PCI Local Bus Motherboard
- Intel 80486DX2-66 Processor
- 256K High-Speed Cache
- 8 Mb High-Speed RAM
- 32-Bit PCI Local Bus SCSI Interface
- 340 Mb SCSI Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 15" SVGA .28 Non-Interlaced Digital Color Monitor
- PCI Local Bus Accelerated SVGA Video Card
- Dual Speed Multimedia CD-ROM Drive
- 3 Disk CD-ROM Software Library
- 16-Bit High-Performance Sound Card
- Digital-Quality, Compact Speakers
- Internal 14.4 Modem
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- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- Full-Tower Case
- FREE Microsoft DOS 6.2 Installed
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486DX-33 $2769
#006616

486DX2-50 $2849
#006617

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MidWest Micro

Elite 486SX/DX Notebook

SL-Enhanced Processor
Up to 340 Mb HD
PCMCIA Type III

A Dream Come True

Almost every ancient Egyptian dreamed of having a portable computer. Thanks to the 486SX/DX Notebooks, their dreams can come true for you.

These Elite Notebooks feature Intel's "SL-Enhanced" microprocessors, delivering excellent power management and a long battery life. The centerpiece of SL Technology is the System Management Mode (SMM), which allows your Notebook to slow down, suspend or completely shut down various components of your system.

The 486SX/DX Notebooks come with a divine gift—the gift of choice. Depending on your specific needs, choose from a 120, 200 or 340 Mb hard drive, an upgradeable 486SX-25, 486DX-33, 486DX2-50 or 486DX2-66 processor and a large 10" monochrome, dual-scan color or active-matrix color screen.

Elite's 486SX/DX Notebooks also feature the latest PCMCIA technology. They all have a PCMCIA Type III slot, which accepts two Type I cards, two Type II cards or one Type III card. Use these cards to add memory enhancements, network adapters, modems and more.

Buy the notebook ancient Egyptians only dreamed of—order your Elite 486SX/DX Notebook today.

120 Mb	486SX-25	486DX-33	486DX2-50	486DX2-66
Monochrome	#005501 $1439	#005516 $1639	#005531 $1649	#005546 $1839
Dual-Scan Color	#005506 $1999	#005521 $2239	#005536 $2249	#005551 $2429
Active-Matrix Color	#005511 $2969	#005526 $3169	#005541 $3179	#005556 $3359

For a 200 Mb hard drive add $100, For a 340 Mb hard drive add $240

Treasures:

Processor:
Intel 486SX-25, 486DX-33, 486DX2-50 or 486DX2-66
SL-Enhanced upgradeable processor

RAM:
4 Mb, expands to 20 Mb

Hard Drive:
120 Mb, 200 Mb or 340 Mb

Screen:
10", 640 x 480 VGA resolution
Backlit display
Color - 256 colors
Monochrome - 64 gray shades

Battery Life*:
Active Color - 3 hours
Dual-Scan Color - 4 hours
Monochrome - 6 hours

Weight:
Color - 6.9 lbs.
Monochrome - 6.4 lbs.

512K DRAM with turbo bus accelerated video technology
Simultaneous video on active-matrix color and monochrome units
86 keys with 101-key emulation
Built-in trackball

Built-in 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type III slot/ two Type II slots
FREE AC adapter and utilities disk
FREE MS-DOS 6.2 installed
FREE carrying case

Elite 486SX-25 SubNote

Ancient Egypt is known for great myths, historical treasures and powerful dynasties. You can discover another source of great power with Elite's 486SX-25 SubNote.

The 486SX-25 has the latest features, like Intel's "SL-Enhanced" processor, Advanced Power Management and PCMCIA technology.

It's a mystery how a little 3.9 lb. SubNote contains as much power as a desktop, but it does. The 486SX-25 comes with 4 Mb of RAM, expandable to 12 Mb, a fast 25 MHz processing speed and your choice of a 120, 200 or 340 Mb hard drive. It also delivers excellent 640 x 480 VGA resolution on its 10" high-contrast screen producing clear, concise images that even a mummy can easily see!

Elite's unforgettable SubNote symbolizes power, ground-breaking technology and true portability. Before you hop on your camel to start your next historical journey—call MidWest Micro and order the 486SX-25.

Treasures:

Processor:
Intel 486SX SL-Enhanced processor
Processing Speed:
25 MHz
RAM:
4 Mb expands, to 12 Mb
Hard Drive:
120 Mb, 200 Mb or 340 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
64 gray shades
Battery Life*:
5 hours
Weight:
3.9 lbs.

512K DRAM with turbo bus accelerated video technology
Simultaneous video
83 keys with 101-key emulation
Built-in trackball
External 1.44 Mb, 3.5" floppy drive
Advanced Power Management
Nickel metal hydride battery
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type II slot
FREE AC adapter and utilities disk
FREE MS-DOS 6.2 installed
FREE carrying case

486SX-25 SubNote		
120 Mb	#005576	$1439
200 Mb	#005577	$1539
340 Mb	#005578	$1679

Elite 486SLC2-50 Color/Monochrome Notebook

Discover the riches of the land with your Elite 486SLC2-50 Notebook. This portable is perfect for long journeys due to its compact size and energy-saving SUSPEND/RESUME feature. You can even compute up to six hours on a single charge!

Available in color or monochrome, the Elite comes with a fast 50 MHz processor, internal cache memory and up to 8 Mb of RAM—giving you more power for your money!

Both 486SLC2-50 models have a record of unparalleled success in eliminating distortion and eyestrain with their non-glare VGA screens. Images appear at up to 640 x 480 resolutions in 64 gray shades or 256 colors revealing eye-catching text, graphics and hieroglyphics.

Your Elite's LCD panel lets you know which drives are being accessed, when battery power is low, what function keys are enabled, whether external power is being used and if there is a modem ring. All the information you desire is right before your eyes!

The wait is over for both you and the Pharaohs. Your Elite Notebook is here—and it's just a toll-free phone call away.

Treasures:

Processor:
Cyrix 486SLC2-50
Processing Speed:
50 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
120 Mb or 200 Mb
Floppy Drive:
Built-in 1.44 Mb 3.5"
Screen:
Color - 9", 256 colors
Monochrome - 10", 64 gray shades
Video RAM:
512K
Keyboard:
83 key with 101-key emulation
2-button thumball mouse
Weight:
Color - 5.7 lbs. with battery
Monochrome - 5.4 lbs. with battery
Battery Life*:
Color - 4 hours
Monochrome - 6 hours

640 x 480 resolution
Simultaneous video
Advanced Power Management
One parallel and one serial interface
External VGA monitor and keyboard connectors
FREE AC adapter, carrying case and MS-DOS 6.2 installed
One year manufacturer's warranty

	120 Mb		200 Mb	
Color	#005476	$1659	#005477	$1739
Monochrome	#005482	$1279	#005483	$1349

*Battery life measured with Power Management enabled. Actual battery life may vary.

MidWest Micro
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LQ 1070	$355	LQ 1170	$589
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STYLUS 800 INKJET $279
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ACTION 1500 6PPM, PCL5 ..... $639

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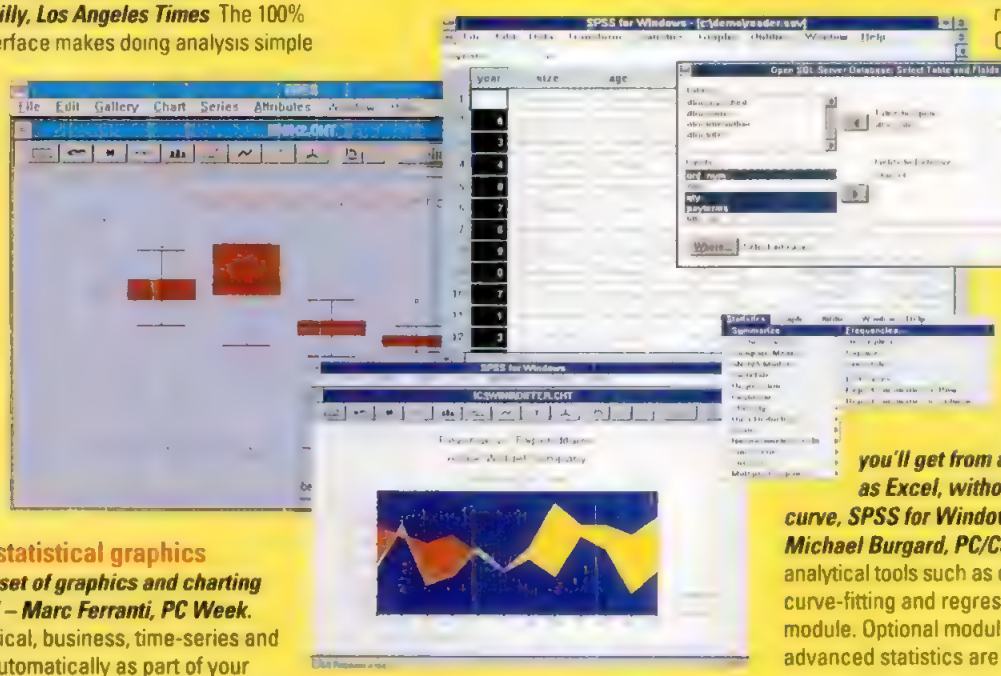

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	338		706	828	898	1,058	1,118	1,188
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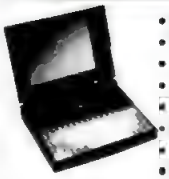

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- Anti-Virus Software
- Multi I/O - 2 Serial and 1 Parallel
- High performance-Tactile Keyboard
- MS-DOS 6.2, Windows 3.1

System 1	System 2	System 3	System 4	System 5
All Standard Features+	All Standard Features+	All Standard Features+	All Standard Features+	All Standard Features+
Intel 486SX25	Intel 486SX33	Intel 486DX33	Intel 486DX2/50	Intel 486DX2/66
210MB hard drive	210MB hard drive	340MB hard drive	424MB hard drive	424MB hard drive
4MB RAM	4MB RAM	4MB RAM	4MB RAM	8MB RAM
14" .28 non-interlaced monitor	14" .28 non-interlaced monitor	14" .28 non-interlaced monitor	14" .28 non-interlaced monitor	15" .28 non-interlaced monitor
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REMOTE DIAGNOSTICS	YES				FEAR	
24 HOUR TELE-TECH SUPPORT	YES			YES	YES	YES
FREE ON SITE SERVICE	YES	YES	YES		YES	YES
OPEN 7 DAYS / WEEK	YES	YES		YES		
EXPRESS PARTS SERVICE	YES	YES	YES	YES		
FAX TECHNICAL ADVICE	YES					
SYSTEM FEATURE						
ANTI VIRUS SOFTWARE	YES					
FREE FAX MODEM	YES					
SERVICE VALUE RATING	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★

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- Desktop Metal Case
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- Remote Diagnostics Software
- 9600/2400 send/receive Fax/modem
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If you're after high speed Windows performance, the VESA local bus systems from Expotech deliver. By using the latest in VESA local bus technology these systems blow away the competition at prices that prove Expotech is the value leader.

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System 1	System 2	System 3	System 4	System 5
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250MB hard drive	340MB hard drive	424MB hard drive	424MB hard drive	527MB hard drive
4MB RAM	4MB RAM	4MB RAM	8MB RAM	16MB RAM
14" .28 non-interlaced monitor	14" .28 non-interlaced monitor	14" .28 non-interlaced monitor	14" .28 non-interlaced monitor	15" .28 non-interlaced monitor
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- Desktop Metal Case
- Remote Diagnostics
- 9600/2400 send/receive Fax/modem
- 3.5" floppy drive
- Double speed CD ROM
- Stereo speakers
- Stereo sound board
- High performance keyboard
- MS-DOS 6.2, Windows 3.1
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- Webster's Dictionary
- World Atlas

BEST BUY ▼

System 1	System 2	System 3	System 4	System 5
All Standard Features+	All Standard Features+	All Standard Features+	All Standard Features+	All Standard Features+
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4MB RAM	4MB RAM	340MB hard drive	424MB hard drive	424MB hard drive
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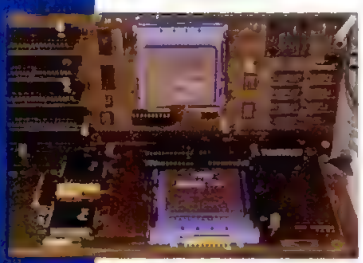
VTECH™ Platinum™

The VTech Platinum 486 SMP systems are the fulfillment of a long standing desire to build a desktop computer that alters the commonly accepted perceptions of a standard desktop computer.



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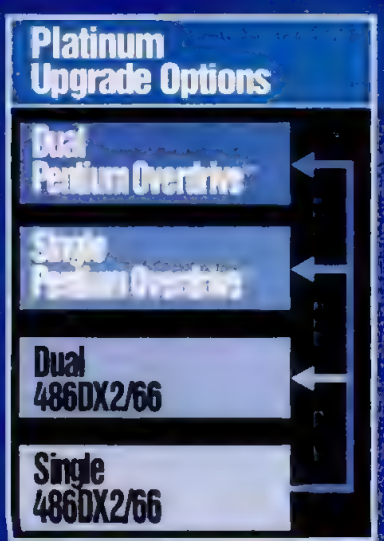

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The most advanced 486 system available

Advanced technology makes the difference.

The VTech Platinum 486 computers are the fastest, most powerful systems available. Imagine a system so fast it can keep up with Dual Symmetrical Multiprocessing Pentium™ Overdrive processors and you'll understand why the VTech Platinum single processor 486 system outperforms all other systems on the market.

Each VTech Platinum 486 is designed with an exclusive copy back cache with cast-out buffering, high performance memory design, VESA Local Bus slots, two cooling fans, on board SCSI II, and self-sensing setup all managed by the industry's most advanced BIOS.

These are just a few of the advanced technology features that make the VTech Platinum computers the highest performing systems available.

The benefits are high performance, ease of use and more upgradability - your system will perform better, work harder and last longer.

The VTech difference

Because we control the complete design and manufacturing process, we can control the quality of our systems. VTech has been an OEM provider to some of the largest names in the business, companies that demand quality and depend on VTech.

We stand behind this commitment of quality with a 3 year warranty and the best customer support in the business. VTech is a name you can depend on.

Upgradability

As your needs change and new software pushes the limits of today's hardware, the VTech Platinum systems can be expanded to meet the challenge.

VTech provides you with three upgrade paths. From the single processor Platinum 486 you can upgrade to dual 486 processors, a single Pentium Overdrive™ processor, or for the ultimate in power and performance, dual Pentium Overdrive™ processors.

The VTech Platinum 486 is the only desktop computer that is Pentium OverDrive Ready and Symmetrical Multiprocessor ready. No more worrying about obsolescence - the VTech Platinum gives you the high performance you need today and the upgradability you'll need tomorrow.

Whether you start with the VTech Platinum 486 Single Processor or choose an SMP Dual Processor System, you're getting the most advanced computer system available.

The bottom line

The VTech Platinum 486 SMP delivers the performance you need for today's software and is unique in its ability to expand to meet the demands of tomorrow's high performance software and operating systems.

Compare these features anywhere and you'll see why the VTech Platinum has already received top recognition from industry experts.

The bottom line - *the VTech Platinum is the best value in high performance computers.*

"VTech delivers a fast multiprocessor system at a single processor price." *Computer Shopper,*

VTech Platinum is SMP ready

The experts agree, your next system should be multiprocessor ready, As *PC Week* said on August 23, 1993, "Multiprocessing is clearly the wave of the future".

The VTech Platinum system features a unique, patented design that brings true Symmetrical Processing capabilities to the desktop. As *PC Magazine* said on October 12, 1993, "VTech leads in PC Multiprocessing".

With Microsoft Windows NT™ the VTech Platinum SMP is an efficient way to double your power. Like a two lane highway that suddenly becomes four lanes, processing flows with greater ease and efficiency.

SMP READY

The VTech Platinum 486 delivers power, performance, upgradability at prices you would expect to pay for basic systems.

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- Intel 486DX2/50 Processor
- Pentium Overdrive™ ready
- SCSI II (on board)
- 256k Cache
- VESA Local Bus
- S3 Windows Accelerator Video Card w/1MB RAM
- 8MB System RAM
- 3.5" Floppy Drive
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- 15".28 Non-Interlaced Monitor
- MS DOS 6, Windows 3.1
- High Resolution Mouse

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486DX2/66 single

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- SCSI II (on board)
- 256k Cache
- VESA Local Bus
- S3 Windows Accelerator Video Card w/1MB RAM
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- 16550 Serial Port Controllers
- 15".28 Non-Interlaced Monitor
- MS DOS 6, Windows 3.1
- High Resolution Mouse

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486DX2/66 plus

- Intel 486DX2/66 Processor
- Pentium Overdrive™ ready
- SCSI II (on board)
- 256k Cache
- VESA Local Bus
- S3 Windows Accelerator Video Card w/1MB RAM
- 16MB System RAM
- Double Speed CD-ROM
- 3.5" Floppy Drive
- 424MB Hard Drive
- 16550 Serial Port Controllers
- 15".28 Non-Interlaced Monitor
- MS DOS 6, Windows 3.1
- High Resolution Mouse

$2999

486DX2/66 dual

- 2 Intel 486DX2/66 Processors
- Pentium Overdrive™ ready
- SCSI II (on board)
- 256k Cache
- VESA Local Bus
- S3 Windows Accelerator Video Card w/1MB RAM
- 16MB System RAM
- Double Speed CD-ROM
- 3.5" Floppy Drive
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- 16550 Serial Port Controllers
- 15".28 Non-Interlaced Monitor
- MS DOS 6, Windows 3.1
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Specifications

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- ZIF processor socket - Pentium Overdrive™ ready

Optional Multiprocessor
- MP Power Card with a second Intel 486DX2/50 or 486DX2/66 processor

Secondary Cache
- 256k Cache (Copy back w/cast out buffering)

Memory
- Supports 4, 8, 16 or 32MB SIMMS Four 72 pin SIMM sockets support 36 bit JDEC style SIMMs which may be inserted in any configuration

Bus Slots
- Six (6) ISA Slots
- Two (2) VESA VL Slots
- One (1) MP Connector Slot

Ports
- Two (2) serial ports 16550-DB9
- One (1) parallel port ECP-DB25
- PS/2 mouse port
- IDE port-floppy controller
- SCSI II connector on board

Chassis
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- Supports three 5.25" or 3.5" external drive bays and one 3.5" internal hard disk drive

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- Supports multiprocessing start-up for advanced SMP capable operating system (Windows NT)
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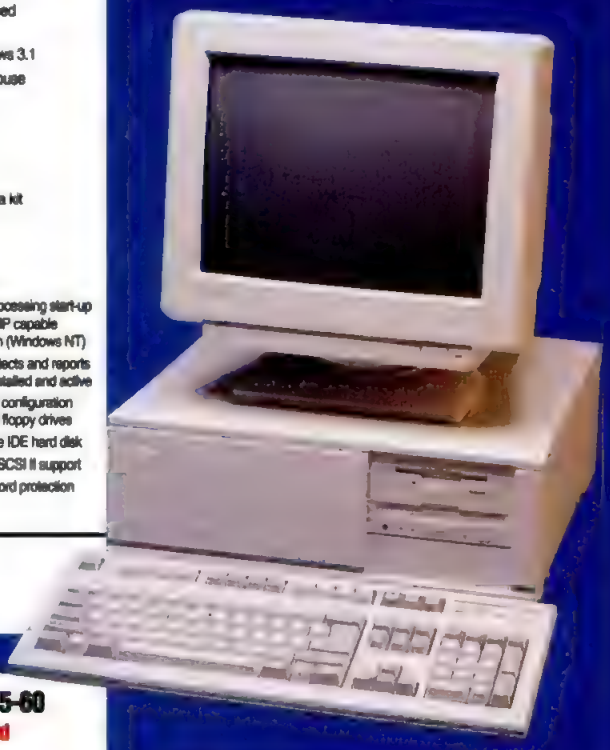

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intel inside

How PC Direct Helped Computer Discount Warehouse Found "Customer University"

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University—which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell—and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a $10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it—closing rate, calls per ad dollar—PC Magazine is tops."

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32Kx8	28.00	9 00	8 00	7 00
64Kx1	–	11 00	9 00	8 00
64Kx4	–	11 00	9 00	8 00
128Kx4	–	8 00	7 00	6 00
128Kx8	–	–	49 00	36 00

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MEMORY FOR IBM & APPLE

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1Megx1	7 35	7 25	6 75	4 95
1Megx4	36 00	29 00	27 00	–
1Megx4 (Zip Pack)	25 00	23 00	21 00	–
256 x 4 (Video Zip)	–	–	11 95	10 95
256x4	4 75	4.50	–	–
256 x1	3.00	2 75	2 50	2 25
256 x16VRAM	–	39 00	39 00	–
64x4	–	–	3 25	–
64x1	–	–	–	2 00

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8087	45 00
8087-2	49 00
8087-1	85 00
80287 XL	55 00
80387 16 DX	45 00
80387-20 DX	55 00
80387-DX (Does All)	79 00
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1Meg x 9 (9 chip)	63 00	–	56 00	54 00	52 00	49 00
4Meg x 9	–	–	195 00	159 00	149 00	–
16Meg x 9 (9 chip)	–	–	829 00	–	–	–
16Meg x 9 (36 chip)	–	–	–	–	–	–

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256 x 36 1Meg	–	–	–	94 00	59 00	–
512 x 36 2Meg	–	–	–	–	67 00	–
1 x 36 4Meg	–	–	214.00	199 00	189 00	–
2 x 36 8Meg (w/pal)	–	–	449 00	429 00	379 00	–
2 x 36 8Meg (w/o pal)	–	–	424 00	444 00	449 00	–
4 x 36 16Meg	–	–	679 00	679 00	679 00	–
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	4Meg	500987 002	199.00
	8Meg	500987-003	419.00
	16Meg	500987-004	619.00
	32Meg	500987-005	1399.00
Premium 486/25, 25E, 33, 33E			
Premium 386/33TE 486/25TE 33TE			
Prem Serv Prem II 386SX/20 25			
Prem II 386/25, 386/33 486/33 486SX/20	0Meg	500780-001	399.00
Premium 386/33T Prem 386SX/16			
Prem II 386SX/20 25		500780-002	189.00
Premium 386/25, 33, 386/33T 386SX/16		500780-003	59.00
Prem II 386SX/20 25		500780-001	59.00
Premia	0Meg	501159-002	CALL
Premia	16Meg	501159-003	CALL
Premia	32Meg	501159-004	CALL
Premia	64Meg	501159-005	CALL

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MODEL	ANT. UPGRADED	AST PART #	PRICE
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30F5360 (2Meg)	30-286, 25 286, 50 MTHR BD.	104.00
6450375 (1Meg)	80-041	79.00
6450379 (2Meg)	80-111, 311-121, 321, 061, 161	84.00
6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	170.00
6450604 (2Meg)	70-061, E61, 121, 50Z, 55SX, 65SX, P 70, 55LS, 65LS, X Station 120 & 130, 35SX, 35LS, 40SX	89.00
6450608 (2Meg), 78X8955 (128K)	70-A21, A-61, E 21, E 61, 35SX, 35LS, 40SX, Val Pt. 325T, 25	90.00 35.00
34F2933 (4Meg)	35SX, 40SX, 56SX, 65SX, 56LS, 65LS	185.00
87F9977 (4Meg)	55SX, 56LS, 65SX, 40SX, 356SX, 36LS	185.00
1057035 (512K)	P/S1 286	49.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	99.00
92F9694 (4Meg)	P/S1 & P/S1/386SX Model-2121	189.00
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07G1415 (4Meg)	Thinkpad 750, 750c	239.00
07G1416 (8Meg)	Thinkpad 750, 750c	449.00
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07G1420 (4Meg)	CL57LSX LpTp Thinkpad 700, 700C, 720, 720C	229.00
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	8Meg Module	116581 001	429.00
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DeskPro 386/25, 386/20	1 Meg Module	113131-001	79.00
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DeskPro 386S-16MHz	1Meg Exp Bd	113633-001	149.00
	4Meg Exp Bd	113634-001	329.00
	1Meg Module	113645-001	79.00
	4Meg Module	112534-001	229.00
DeskPro 386/20E	1 Meg Exp Bd	113644-001	149.00
DeskPro 386/25E	4Meg Exp Bd	113645-001	329.00
	1 Meg Module	113131-001	79.00
	4Meg Module	113132 001	229.00
DeskPro 286N, 386N, 386SX/20, 386/25M, 486/33M, 486S/25M 486S/16M	1 Meg Module	118688-001	59.00
	2Meg Module	118689 001	99.00
	4Meg Module	118690-001	163.00
Port 486C	8Meg Module	128877-001	399.00
M Series Exp Bd	0-64Meg	129160-001	279.00
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DeskPro 5/60 5/66M	16Meg Kit	149949-001	769.00
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	16Meg	149320-001	689.00
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Prosignia 5/60	16Meg	139132-003	739.00
Prosignia 5/60	32Meg	139132-004	1659.00
Prosignia 5/60	64Meg	139130-001	2799.00
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LTE LITE/20 25, 25C	4Meg Module	129769-002	239.00
LTE/ LITE/20 25, 25C	8Meg Module	129769-003	399.00
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LTE LITE 4/25C 4/25E 433C	8Meg Module	142337-003	429.00
LTE LITE 4/25C 4/25E 433C	16Meg Module	142337-004	789.00
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SLT/286	4Meg Module	110237-001	249.00
SLT/386	1Meg Module	118303-001	79.00
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T2000SX/T1000LE	8Meg	PC14-PA8315U	419.00
T2000SXE/2200SX/T1800, 1850, C	2Meg	PC-PA2000U	94.00
T2000SXE/2200SX/T1800, 1850, C	4Meg	PC-PA2001U	219.00
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2002U	419.00
T4400SX, SXC T6400	4Meg	PC-PA2004U	219.00
T4400SX, SXC T6400	8Meg	PC-PA2005U	419.00
T4400SX, SXC T6400	16Meg	PC-PA2010U	719.00
T4500, T4500C, T4600, T1900 T1900C (3 3 v)	4Meg	PC-PA2012U	249.00
T4500, T4500C, T4600, T1900 T1900C (3 3 v)	8Meg	PC-PA2013U	479.00
T4500, T4500C, T4600, T1900, T1900C (3 3 v)	16Meg	PC-PA2014U	1399.00
T3300SL	4Meg	PC-PA2007U	234.00
T3300SL	6Meg	PC-PA2008U	349.00
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T3300SL	16Meg	PC-PA2009U	719.00
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T3100	2Meg	PC3 PA7135E	179.00
T3100e	2Meg	PC9-PA8340U	109.00
T3100SX	2Meg	PC15 PA8308U	109.00
T3100SX	4Meg	PC16-PA8310U	209.00
T3200	3Meg	PC6-PA7137U	185.00
T3200SX	2Meg	PC12-PA8307U	119.00
T3200SX	4Meg	PC12-PA8908	209.00
T3200SXC	2Meg	PC18-PA8318U	119.00
T3200SXC	4Meg	PC19-PA8319U	219.00
T5100	2Meg	PC7-PA8301U	95.00
T5200/T8500	2Meg	PC10-PA8304U	114.00
T5200/T8500	8Meg	PC10-PA8313U	419.00

NOTEBOOK, LAPTOP MEMORY

MODEL	ANT. UPGRADED	MANU PART #	PRICE
ACER 730	2Meg/4Meg/8Meg		109/209/449
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AST Notebook Prem Exec 386SX/20/25/SL	4Meg	500814-003	199.00
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AST Power Exec 3/25C 425EL	16Meg		819.00
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Gateway 2000 Nomad 425 DX/L/SX	4Meg/16Meg		199.00/1549.00
Goldstar GS520 386SX/16	4Meg	S386-4M	299.00
Magnavox Metalis	1Meg, 4Meg	286 386SX	109.00,199.00
NEC Prospeed 286, 386SX-16	1Meg	PC21-21	79.00
NEC Prospeed 286, 386SX-16	4Meg	PC21-22	199.00
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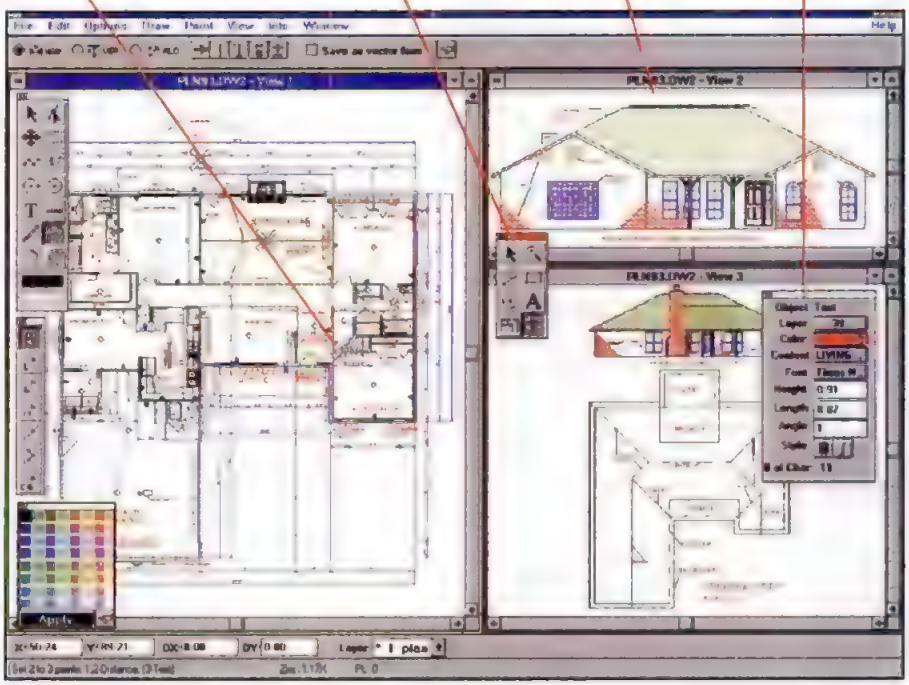

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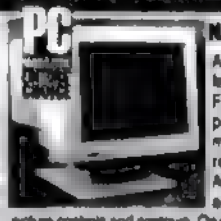

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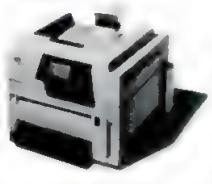

	4039-10R	Laserjet 4
Printspeed	10ppm	8ppm
PostScript	YES	(Optional)
Resolution	600DPI	600DPI
Upgradable Language	YES	NO
Available Duplex Option	YES	NO
MCW Price	$1339	$1368

And the Winner is The 4039-10R from IBM!

IBM vs. HP

	4037-5E	Laserjet 4L
Printspeed	5ppm	4ppm
Paper Input	150 sht.	100 sht.
Optnl. 2nd Drwr.	YES	NO
Fonts	40	26
MCW Price	$655	$674

And the Winner is The 4037-5E from IBM!

IBM vs. HP

	Execjet II 4076	Deskjet 500
Paper Capacity	150 Sht.	100 Sht.
Resolution	600x300	300x300
Cart. Life	1000 pgs.	500 pgs.
Print Speed	300 cps	240 cps
Res. Enhancement	YES	NO
MCW Price	$279	$309

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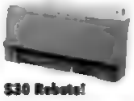

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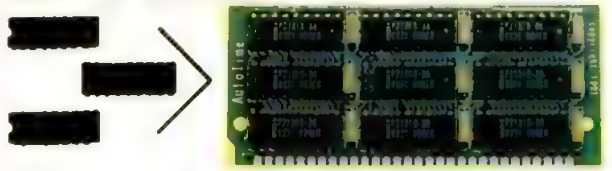

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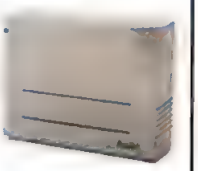

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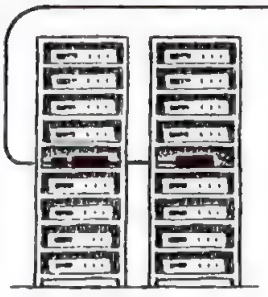

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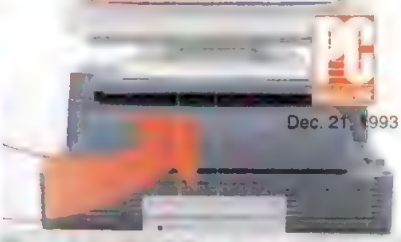

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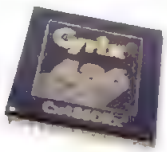

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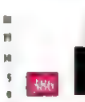

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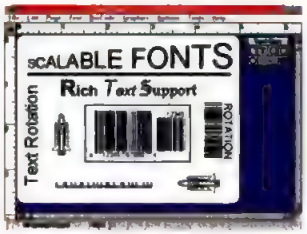

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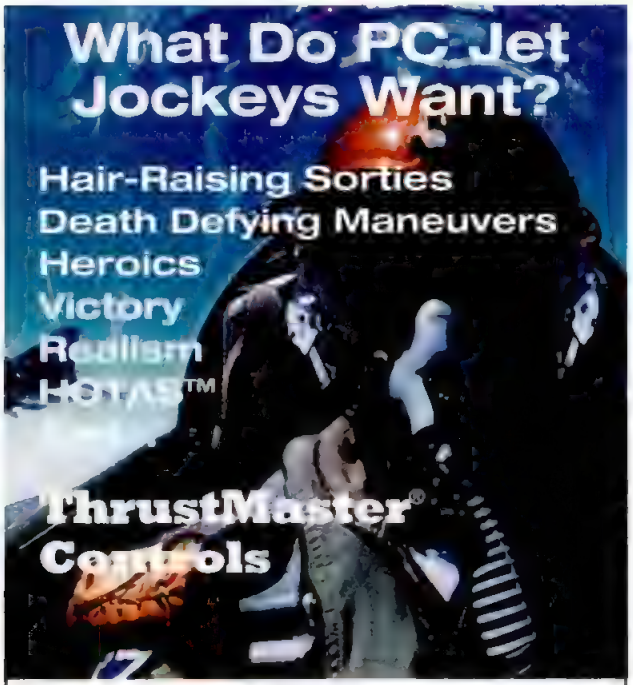

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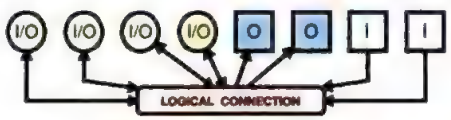

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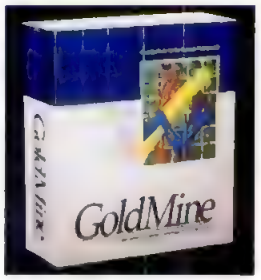

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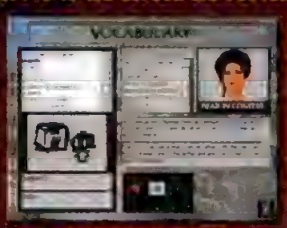

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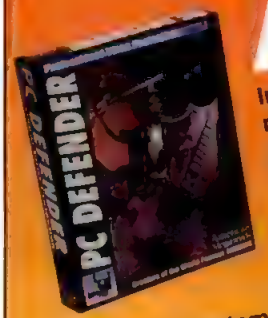

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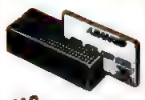

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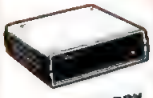

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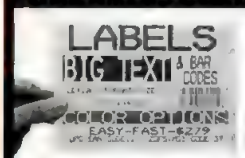

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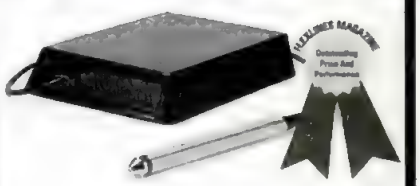

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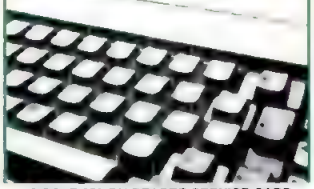

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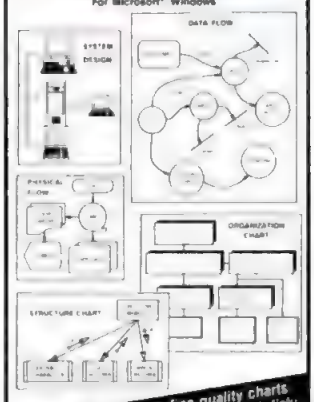

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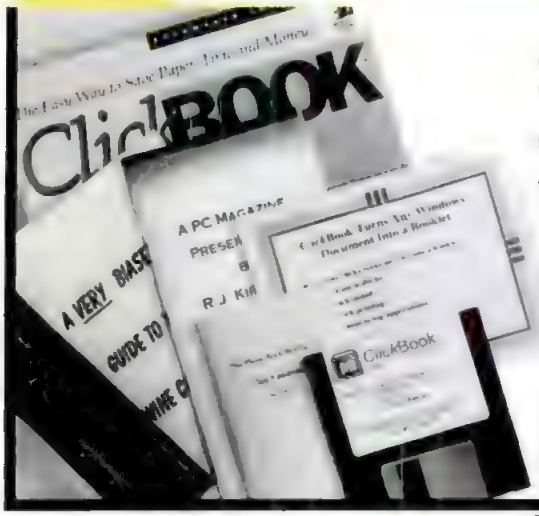

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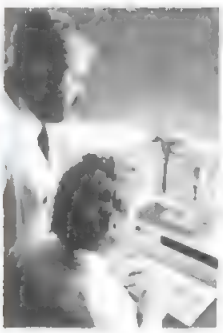

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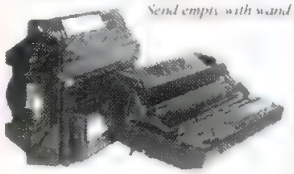

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PC MAGAZINE

Coming Up

On-Line Services

On-line services are quickly becoming the must-haves of the business world, offering powerful communications and information tools to anyone with a PC and modem. America Online, CompuServe, Dow Jones, GEnie, and Prodigy are the big guns, but where do local bulletin boards and the Internet fit in? What new services are on the horizon? We answer these questions and more in a look at the changing electronic landscape of cyberspace.

Application Servers

Client/server applications are on the rise as mini- and mainframe-based computing gives way to PC-based LANs. But application serving demands a powerful processor—or two—and a sophisticated drive subsystem. We test five SMP-capable servers and show their client/server strengths under both NetWare and SCO Unix.

Mainstream Monitors

Not long ago, the mainstream monitor of choice was a 14-inch VGA-only tube. Today, it's a 14- or 15-inch SuperVGA (800-by-600 pixels) display or better. We test 54 of the current crop of 14- and 15-inch multifrequency monitors, priced from $320 to $800.

Tax Software

Personal tax packages, now more than ever, have a rich supply of tax instructions and navigational aids to guide you through the painstaking tax process. We look at DOS and Windows packages that help you make sense of the changing tax codes.

Plug and Play: Easy Upgrades at Last?

Microsoft, Intel, Compaq, and Phoenix Technologies have agreed on a specification that promises to make configuring expansion cards and other peripherals essentially automatic and invisible to the user. We tell you how Plug and Play works and analyze the issues that will determine whether it succeeds or fails.

Extending Your Apps

The WordBasic programming language makes Word for Windows one of the most flexible and easily extended word processors on the market. But once you've created your macro, how do you share it, especially in networked settings? Our Extending Your Apps column offers a Word for Windows template that copies any number of macros to any number of destination templates.

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Spotlight on Greenware: Green Explorer

LANGUAGE SOFTWARE

Three Tutorials Break The English Barrier

FOR KIDS: TriplePlay Spanish targets 9- to 16-year-olds.

BY J.W. OLSEN

What better way to expand your international horizons than by learning a new language? This skill provides a real advantage in business and makes travel abroad all the more rewarding. And you owe it to your kids to help them develop these skills in our ever-shrinking global village.

If you take the plunge, you may want to invest in a microphone and a sound card so you can record and compare your voice with the voices of the native speakers.

Learn to Speak Spanish, from HyperGlot Software Co., gives you 30 lessons that focus on things you might really do—from arriving at an airport and exchanging money to enjoying an evening at a restaurant and going to the doctor. As you read the story in each lesson, you can toggle between Spanish and English.

Each lesson offers features that you can select with icons. You can listen in on a conversation between two native speakers, study vocabulary listings, work on grammar, and take practice drills and tests. In the drills, you can return to incorrect answers, while tests can be extended with users' own questions and answers. Where appropriate, you can read, listen, or print in each mode. You can also bypass stories and skip to grammatical aides.

Lessons are well balanced in their approach to helping you develop verbal and written skills. Complete the program and you will have learned the equivalent of at least two years of classroom training—enough for moderate fluency. With its inviting user interface, this program is a top-notch choice.

TriplePlay Spanish, from Syracuse Language Systems, builds upon the company's existing Playing with Language series and best suits children ages 9 through 16.

TriplePlay teaches 1,000 words and phrases arranged by subject and level, from simple words through complete conversations. Games, rather than lessons and drills, teach and entertain you.

The product uses Microsoft Video for Windows to enhance the graphics. Drag-and-drop functions interactively advance games, and no keyboard input is required.

JUST WORDS: EZLanguage is long on vocabulary but short on instruction.

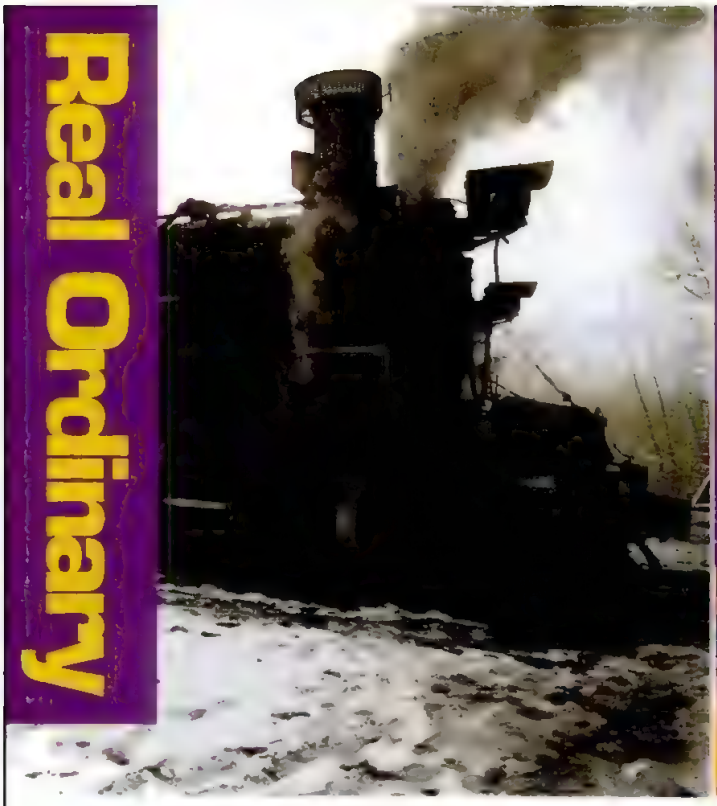
Even though everything is point-and-click, you will frequently consult the manual in the beginning. All spoken dialogue—within the games and also in the menu selections—is in Spanish. TriplePlay focuses on verbal rather than written skills.

FACT FILES

Learn to Speak Spanish, *$99.* Requires: *4MB RAM, 3MB disk space, MPC-compliant audio, CD-ROM drive, Windows 3.1. HyperGlot Software Co., P.O. Box 10746, Knoxville, TN 37939-0746; 615-558-8270.*
Circle 476 on reader service card

TriplePlay Spanish, *$89.95.* Requires: *4MB RAM, 3MB disk space, CD-ROM drive, Windows 3.1. Syracuse Language Systems Inc., 719 E. Genesee St., Syracuse, NY 13210; 800-688-1937, 315-478-6729.*
Circle 478 on reader service card

EZLanguage, *$49.95.* Requires: *4MB RAM, 9MB disk space, Windows 3.0 or later. Future Trends Software Inc., 1508 Osprey Dr., #103, DeSoto, TX 75115; 800-869-3279, 214-224-3288.*
Circle 475 on reader service card



There's more to games than a mouth that sort of moves or tinny sound. Now there's a new way to play PC games that's just like sitting in a theater controlling the action with your joystick.

It's ReelMagic,™ the new MPEG playback adapter. Available only from Sigma Designs. This incredible add-in board brings the next generation of CD-ROM games to your PC bigger than life.

ReelMagic™

Say adios to wimpy graphics. Herky-jerky movement. Bogus sound. And phony scenarios. ReelMagic pumps up the reality meter so you can crank up the fantasy.

256 VS. 32,768 COLORS Why settle for a mere 256 colors, offered by current PC games, when ReelMagic gives you theater-quality graphics with over 32,000?

GRUNTS VS. CD-QUALITY AUDIO Get 16-bit CD-quality sound that plays Sound Blaster™ and Windows™ compatible software. The 8-bit audio you're used to just doesn't compare.

5 FPS VS. 30 FPS ReelMagic-compatible games run at 30 frames-per-second, TRUE full-motion, so you avoid jerky, blocky images.

1/4 VS. FULL SCREEN Now you can get theater-quality video in a full-screen image for a realistic, movie-like experience.

We've also included Activision's *Return to Zork* so you can experience the excitement of full motion video now.

It's not real unless it's ReelMagic. Call 1-800-845-8086 ext. 320 for a dealer demo near you. Or you can stick with real ordinary. Oh joy!

Only ReelMagic Makes It Real.™

SIGMA DESIGNS®

CIRCLE 399 ON READER SERVICE CARD

Discover the new generation of ReelMagic games from these manufacturers, and look for more exciting titles coming soon.

ACTIVISION · SIERRA · trilobyte · Interplay · Virgin GAMES · COMPTON'S NEWMEDIA · READYSOFT · aris entertainment · ACCESS

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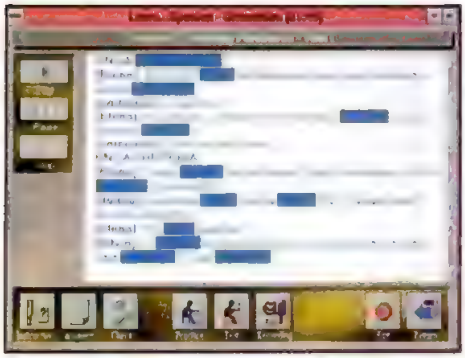
Language

If you're less worried about grammar—and more concerned about knowing words—you'll ease right into **EZLanguage,** from Future Trends Software. Though it is interspersed with other material, EZLanguage is essentially a computerized flash card–style vocabulary builder with multiple-choice tests. You begin by choosing one of eight lessons—Basic Phrases, Eating Out, or Sports, for example. The lessons present a total of 400 Spanish terms, each accompanied by a graphic to develop word/object association. You can search for an English word to view its translation and location within the drills.



BEST BET: Learn to Speak Spanish fulfills its promise.

EZLanguage also ships in French, German, Italian, Japanese, and Russian versions. Modules for students, businesspeople, and native speakers of other languages can supplement the main product, while a CD-ROM offering all six languages is available for $99.95. You won't develop much sense of context or grammar, but if you're only trying to gain a surface knowledge of the language, you will find EZLanguage quite useful.

Hell Cab: A Funky Journey To Save Your Soul

CD-ROM PICK HIT

Get ready for the ride of your life. In Hell Cab, you board the wrong taxi at New York's JFK airport, and your driver, Raoul, is about to exact his price: your money or your soul. Since you're always short on the former, you have to save the latter. You ride to the Empire State Building (an effective Mephistophelian metaphor), then do battle in the Colosseum, in World War I Germany, and on Jurassic earth. Your decisions determine how much of your soul you keep.

Hell Cab's graphic detail, twisted humor, and funky background music beat just about anything currently available. Without a fast CD-ROM drive and lots of memory, though, you'll have a devil of a time waiting for screen redraws. If you have the hardware, this game is a tempting treat.—Julie Cohen.

Hell Cab, $99.99. Time Warner Interactive Group; 818-955-9999.

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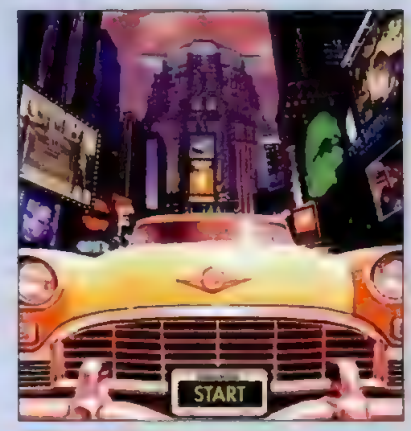

BUCKLE UP!: The ride is bumpy.

ADVENTURE

Shadowcaster: No-Fuss Fantasy

BY BRENDON MACARAEG

Looking for an adventure game that takes little memorization or management skill? While Origin Systems' $69.95 Shadowcaster fits that description, this three-dimensional game offers enough challenge to keep you busy for days.

Shadowcaster places you in the role of Kirt, a human descendant of a shape-changing race. The minimal plot requires you to navigate through the many levels of various worlds, kill the monsters in your way, and eventually have a showdown with the evil god Veste.

Most functions, like morphing, changing directions, jumping, attacking, and selecting weapons, are done with a mouse click.

3-D FUN: Shadowcaster has plenty of slash-and-kill adventure.

An introductory walkthough, in conjunction with the manual, helps accustom you to picking up and dropping items, selecting weapons, attacking, and navigating.

Although Shadowcaster will run on a 386/33-based PC, the redraws of the 3-D scenery in the default-size view window are somewhat slow; walls in the distance aren't fully drawn until you walk more than halfway to them. To speed up the game play, Shadowcaster features Size Gems and Automap. Size Gems allow you to enlarge or shrink the view window so screen redraws and animations are faster and smoother. Automap brings up a grid-like view of the current area you are in, as well as an overall level map that shows you the ground that you have covered.

Shadowcaster stands out for its ease of use and its look and feel (it uses a version of the same 3-D texture-mapping engine used in Apogee's Castle Wolfenstein-3D). But its lack of a plot will leave many users wishing for more complexity.

Shadowcaster, *$69.95. Requires: 4MB RAM, 16MB disk space, DOS 5.0 or later. Origin Systems Inc., 12940 Research Blvd., Austin, TX 78750; 512-335-5200; fax, 512-321-0063.*

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ADVENTURE

A Midkemian Betrayal

BY MARINO DELZOTTO

BOOKS ON-DISK: Fantasy novelist Raymond E. Feist continues his Riftwar Saga in an interactive game.

The Riftwar is over, but the adventures in Midkemia have just begun. Raymond E. Feist, author of the best-selling Riftwar Saga, has teamed up with Dynamix to create an extraordinary interactive continuation of his literary trilogy.

The object of Betrayal at Krondor is to complete nine major tasks, one in each chapter. The complexity of play changes from chapter to chapter. In the first chapter, for instance, your party's only duty is to get Gorth to Krondor. Later, you and your party must complete several difficult assignments in order to reach your objective. Along the way, you'll encounter Fairy Boxes and sealed chests. When you get inside them, you'll find gold, weapons, and notes.

Betrayal at Krondor's graphics will make you feel as if you are a real part of the story. The three-dimensional scenery was created from digitized images of outdoor landscapes and painted sets. Many of the characters are based on live actors, and the battle sequences were first videotaped with actors, and then digitized to lend realism. The game is truly an interactive marvel.

Betrayal at Krondor, *$69.95. Requires: 2MB RAM, 15MB hard disk space, DOS 5.0 or later. Dynamix Inc., 1600 Millrace Dr., Eugene, OR 97403; 800-326-6654, 503-343-0772; fax, 209-683-4297.*

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MULTIMEDIA

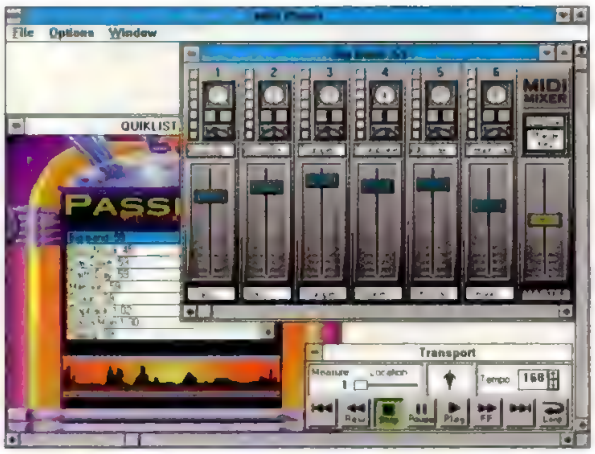
Hello!Music! Hello, Painless MIDI!

BY ROBERT KENDALL

If you want high-quality MIDI music from your PC but don't want to mess with expansion boards, Yamaha Corp. of America's Hello!Music! is for you. This uniquely flexible hardware and software bundle features Yamaha's CBX-T3—a high-end, MIDI-tone–generating module that attaches directly to a serial port on your PC. You also get a collection of music clips and two simple but elegant Windows programs to work with MIDI music.

Connecting the CBX-T3 to a serial port with the provided cable and installing its Windows driver was easy. When we hooked it up to a 486DX2/66-based PC, we had no compatibility problems. The module comes with all the cables and adapters you will need to connect its stereo-line output to headphones or an audio amp. It also holds the standard MIDI In, Out, and Thru ports, so you can connect a MIDI keyboard. You can connect the module via a MIDI cable to a sound board already installed in your PC. If you have a sound board with a crummy built-in FM synthesizer, the latter option provides an easy way to upgrade its MIDI sound.

The CBX-T3 uses wavetable lookups to access 192 samples of real instrument sounds stored in ROM. It can emulate nearly any instrument with a high degree of accuracy, comparable with that of high-end synthesizers available from E-mu Systems and Roland Digital Group. The CBX-T3 conforms to the General MIDI standard used for most commercially available MIDI files. It supports 16 multitimbral voices and 28 polyphonic notes, so it can play complex music with aplomb.



SOFTWARE INCLUDED: Hello!Music! lets you edit MIDI files.

Bundled with the hardware is Passport Designs' MIDI Player software, which lets you play MIDI files, compile song lists, and create graphical light shows. Even if you're not a musician, you can edit like a pro. You have full control of the track volumes, panning, instrument timbres, tempo, and key

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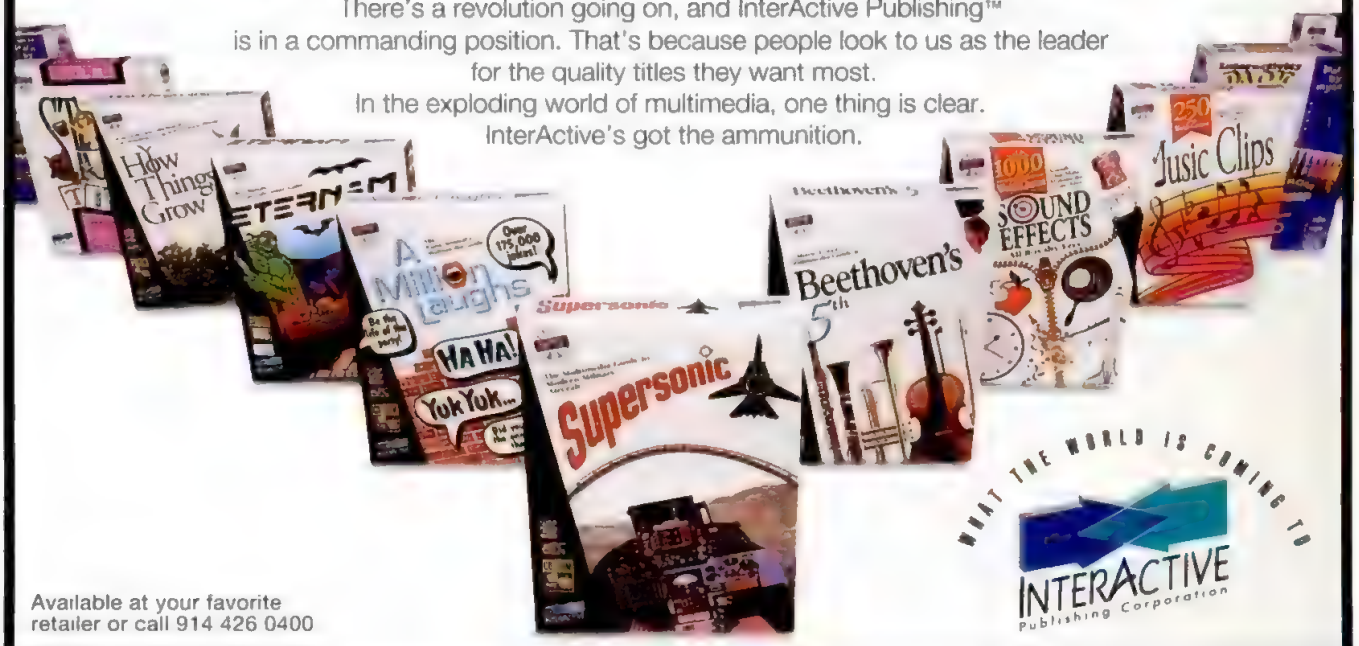

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WHAT THE WORLD IS COMING TO

INTERACTIVE Publishing Corporation

CIRCLE 120 ON READER SERVICE CARD

Hello!Music!

of MIDI files. Just move the controls on a graphical mixer console to set values.

Hello!Music! also includes Passport's entry-level, 64-track sequencer. This program gives you extensive editing control over MIDI sequences, letting you edit individual notes with a piano-roll note editor that depicts notes graphically. You can also cut and paste sections, create graduated tempo and dynamic changes, and record from a keyboard. Missing are on-line help and a way to edit most continuous controllers. □

Hello!Music!, *$449.* Requires: *4MB RAM, serial port or MIDI interface board, headphones or amplified speakers, Windows 3.1. Yamaha Corp. of America, P.O. Box 6600, Buena Park, CA 90622; 714-522-9937.*

Circle 481 on reader service card

SPOTLIGHT ON GREENWARE

Ecologically Correct Shopping

by Melissa J. Perenson

Filled with environmental facts, tidbits, and tips, Green Explorer both disseminates information and educates users on how to become more ecologically aware.

Green Explorer clearly has children in mind. Its many activities and science projects can help young minds better understand processes like purifying water and making recycled paper. A history section reveals everything you want to know about—among other things—garbage, covering topics such as environmental issues, disposal methods, and recycling.

A Home Tour takes you on a walk-through tour of a house and provides home-improvement pointers and shopping suggestions to help cut costs and conserve resources.

ENVIRONMENTALLY CORRECT: Green Explorer provides more than 1,000 listings.

A database contains addresses and phone numbers of more than 1,000 organizations tied to environmental issues.

At times, the program crosses the line between heightening awareness and trying to launch a crusade. The text can be repetitive, and though many suggestions are helpful, some are merely exercises in common sense.

Still, Green Explorer is chock-full of valuable information.

Green Explorer, *$79.95.* Requires: *2MB RAM, 4MB hard disk space, Windows 3.1. MicroBase Inc., 3923 S. McClintock Ave., #402, Tempe, AZ 85282; 800-897-3637, 602-897-7800; fax, 602-897-9799.*

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MOVING?

Please write to: PC Magazine, P.O. Box 54093, Boulder, CO 80322. Include your mailing label from a recent issue of PC Magazine for faster service. Please allow up to 60 days for change of address to take place.

[*Hillary not included.]

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By Don Willmott

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(DellWare catalog.)

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—*THE NEW VISION*, KAMPALA, UGANDA

ARF on the road: Ingram, Texas.

USDA sows plan to overhaul systems

Common architecture would benefit farmers dealing with multiple agencies

By Gary H. Anthes and Jean S. Bozman
WASHINGTON, D.C.

ing program here. "That currently doesn't exist [here at the agency]."

Some 45,000 end users will be affected

ers need to be updated, farmers said. Ronald Robles, a farmer who serves on vision board

according to Kroshus.

However, the exact specification the USDA's new systems may not ironed out for a year. Standards comp ance will for in deciding

Read this *Computerworld* headline quickly, then slowly, then quickly again.

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Richard Tennant

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: Douglas Boyd, Evelyn Casper, John Huber, R. Troy Keiper, Godfrey Kyedza, Creede Lambard, and John Powell.

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†1993 J.D. Power and Associates Desktop Personal Computer Satisfaction Study. Study conducted among business users in the U.S. and based on 1,956 user respondents.